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QUARTERLY

OF THE

National Fire Protection Association

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National Fire Protection Association.

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January 1917.

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Western Factory Insurance Association.
Western Improved Risk Association.
Western Insurance Bureau.
Western Sprinklered Risk Association.
West Virginia Inspection Bureau.
Wisconsin Inspection Bureau.
Wisconsin State Fire Prevention Association.

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Reports on fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

FIRE FIGHTING EMPLOYEES OF A CLEVELAND DEPARTMENT STORE.

Halle Bros. Co. operates a department store in Cleveland having a floor area of about ten acres. The manager recently gave an exhibition drill of his fire-fighting force in honor of the visit of President Charles E. Meek of the National Fire Protection Association.

The fire extinguishers are distributed in various parts of the building, also other apparatus, and upon signal the employees go quickly to their stations, and after equipping themselves with the apparatus gather at the point where the fire is supposed to be. The building is a very large one, being thirteen stories high, and twelve hundred persons are employed in it. It has sprinkler equipment and eight extinguishers to each floor, self-closing doors, wired glass protection, etc. Included in the fire-fighting force is a salvage corps, a first-aid corps, and a smoke-helmet corps. On the average, sixty-five men respond to a fire alarm, the time being one and one-third minutes.

Don't worry about a defective flue — the neighbors will help you move out the things. — *J. S. Speed.*

The Quarterly

Vol. 10 January, 1917 No. 3

The News Letter. The Association's *News Letter* although now only in its fourth month has already established itself as a necessary and expected National Fire Protection Association service. A former president of the Association once said that we have the most critical lot of members ever assembled under a common banner. A critical member means however an interested member and the unsolicited words of commendation for the *News Letter* that have come to the executive office during the past three months testify to this interest and pride in any effective work the Association may do. These letters have come from all parts of the country and all classes of members.

Manager E. A. Sterling of the National Lumber Manufacturers' Association writes from Chicago on December 4th:

My dear Mr. Wentworth:

The receipt of your interesting News Letter No. 3 leads me to advise you of the results of the publication in your News Letter No. 2 of a note about our Technical Letters Nos. 4 and 5.

Up to the present time we have received 44 inquiries for these Letters which referred directly to your News Letter. The pamphlets have, of course, been forwarded promptly, and I hope will do some good.

Even our good friends in England, the British Fire Prevention Committee, while harassed by fires from Zeppelin bombs and the many other causes resulting from the war found time to write the following gracious letter:

8 Waterloo Place, Pall Mall, London, S. W., Oct. 19, 1916.

Dear Sir,

At our Meeting this afternoon your interesting News Letter of October 1st was put forward, and we desire to take this opportunity of congratulating you on this very excellent idea, and the remarkably able manner in which this new means of encouraging interest in fire protection has been put forward by your excellent Association.

If the occasion arises we shall certainly not fail to let you have some items of news which we think may be of technical interest to you, and in the meantime offer you our sincere congratulations on this new development of your work.

I am, dear Sir, Yours very truly,

For THE BRITISH FIRE PREVENTION COMMITTEE.

Franklin Wentworth, Esq. (signed) Edwin O. Sachs, *Chairman.*

National Fire Protection Association, Boston, U. S. A.

We have also received letters from editors of publications on our exchange list expressing gratification that they were to have first hand news of the Association's activities presented in succinct paragraphs which they may so easily clip and print.

Electric Pressing Iron Bulletin. The National Fire Protection Association bulletin on the hazards of Electric Pressing Irons met with such a cordial reception as to fortify our opinion that the misuse of this extremely handy household device is causing an increasing number of fires. A California member writes that two fires from this cause were reported to him on the day the bulletin reached his desk. Ten thousand copies have already been circulated. Experts of our member the National Electric Light Association were offered the bulletin for criticism before it was sent out and contributed helpful suggestions. In commenting on the subject the Chairman of the National Electric Light Association Committee on Wiring said:

> One argument for the irons is of course that they can be plugged into a lamp socket, and this is dangerous, partly because it leads people to use them on their lighting circuits, and partly because there is a danger, though a slight one, in the socket itself.
>
> If, however, a user realizes this danger, and attempts to change the socket for a receptacle, either with or without a pilot lamp, then in many inspection departments the wireman is required to run a separate circuit back to the meter, involving a $10 or $15 expense.
>
> If, however, the customer refuses to pay this charge at all, the inspector, in practice, does not interfere with the use of the iron on the lamp socket.
>
> In other words, the inspectors take the position that if a man tells them he is going to use a flat-iron in a particular place, they will make him pay for a separate circuit; but if he does not tell them, he can still use it there just the same because they would not know about it.

If this is a correct statement of this phase of the situation more backbone in the inspection departments might make for a reduction in losses from pressing iron fires.

* * * * *

Improved Wiring for Electric Ranges. The *Electrical Review* comments favorably upon an address of Mr. A. L. Smith of the Boston Edison Company delivered recently at a meeting of the New England section of our member the National Electric Light Association on the subject of better wiring from supply circuits to electric ranges.

This matter is much more within the control of central stations than the matter of safeguarding electric pressing irons and with a little more co-operation on the part of contractors, improvements can be effected with very little expense. Singularly enough, Mr. Smith stated, the part of the installation that is in a way most important, is the one most neglected, viz., the main-line switch. Both contractors and central stations that do their own wiring are prone to use a jack-knife switch with fuse clips below for main-line fusing, usually mounted within a box of iron permanently grounded. Often a switch box is around the corner from the range, and in many instances the connection to the range is made by leads covered with circular loom or by wires taped into one cable.

Now the kitchen is about the last place in the house where live parts and bare contacts should be exposed, especially on 220-volt circuits. It

is entirely within the compass of modern wiring to provide safe and convenient installation of range circuits. Loose or dangling wiring is most objectionable around a kitchen, and the use of permanent wiring, preferably in rigid pipe, flexible conduit or armored cable, with the minimum visibility, is most desirable. Another improvement much needed is the use so far as possible of main-line switches of the snap or rotary type, mounted rigidly in an approved steel box or fitting, and located within sight of and near the range.

With the increasing demand for electric ranges (1,600 or more are now reported to be in use in New England alone), the manufacturer of wiring equipment should turn his attention to the development of special sets of fittings arranged in compact form and suitable for range connections under varied conditions. There is little question that it would pay to develop equipment of this kind, in view of the success now being attained in the design and construction of meter panels for apartment-house service. It makes little difference to the range owner whether the service resulting is temporarily unsatisfactory on account of the wiring between the service entrance and the range or because of some failure to learn how to get the best results in the use of the latter; and the central station will do well in the light of Mr. Smith's suggestions to see to it that it does not lose good business and continued patronage through the failure to provide the range owner with a wiring installation of first quality in every possible case.

* * * * *

Fire Protection beyond City Limits.

Growing settlements outside the limits of cities are continually encountering the problems of water service and fire protection and have been somewhat prone to assume that the adjacent city should furnish the latter, if not the former, if only on the grounds of humanity. In the days of horse-drawn fire apparatus fire chiefs were reluctant to tire out their teams by long runs to fires outside the city boundaries, but the possession of quick-running motor engines and chemical apparatus has softened the hearts of the chiefs somewhat.

It is obvious that such service should not be left to chance or to the good will of a fire department, but if desired should be contracted for upon an equitable basis. It is not impossible to secure the extension of metropolitan water mains beyond city boundaries both for domestic consumption and for fire protection, and there are numerous examples of such co-operation. In some cases the city owns the distributing system extending into the suburbs: in others the suburban town or district owns it. Detroit is an example of the first case; Chicago of the second. Chicago supplies Forest Park and Blue Island with water distributed from mains owned by the latter communities, the water being measured by a meter set on the main at the city line and payment made accordingly. Columbus, O., supplies a neighboring community which owns its own distributing mains.

The Metropolitan water board of Massachusetts supplies about twenty cities and towns, each owning its own distribution system; all the water supplied to each community is metered, and payment is made in part in proportion to measured consumption and in part in proportion to property valuation. This latter may be considered in the nature of a standby charge for furnishing service, thus both the element of normal consumption and that of readiness to serve for fire protection being considered.

There are cases where the services of a city fire department are furnished adjoining cities at a specified rate. No one could undertake to say offhand what that rate should be. Both this and the arrangement with respect to water service are matters of which the details obviously have to be worked out after full consideration locally of the conditions involved.

There has recently been considerable speculation as to just what can and should be done for fire protection in county territory outside the city limits of Salt Lake City. In answer to an inquiry from Sheriff J. S. Corless, the county attorney, H. L. Mulliner, stated in an opinion that while the sheriff is required by law to extinguish fires on the public domain, he cannot call on the city fire department for aid, and the county is not authorized to incur any liability therefor. This letter to the sheriff supplemented an opinion which was recently given to the County Commission by the attorney, who took the position that the county could not pay a claim held by the city for furnishing fire protection to districts outside of the city limits. The county attorney is of the opinion that the only provision for fire protection in rural communities is the formation of mutual insurance companies, until the population reaches such a point that they may become incorporated as municipalities. The mutual insurance organizations would not necessarily be for insuring the property of their members, but instead, they could lend their efforts toward raising funds either for the purchase of light motor fire apparatus best suited to serve the purposes or for securing protection from the city at a set figure. The scheme of having small rapidly-moving fire trucks to handle fires in the rural communities has met with success wherever instituted. If, however, conditions are thought to be such that city aid can be had at a figure less than the cost of purchasing and maintaining these fire trucks, a reasonable price can be agreed upon for answering alarms. With the great improvements made in roads and also in the mobility of fire apparatus, co-operation with surrounding districts should be the aim of cities. And, too, the fact that the fire loss of a state is frequently taken into consideration by insurance companies when adjusting rates for that state should alone be incentive enough for city taxpayers to aid in reducing fire losses by offering whatever aid they can conveniently give through the agency of their fire department.

The growing co-operation of nearby cities in fire fighting, of which the first step is the standardization of hose couplings and hydrant fittings, is a sign that the people are beginning to realize that a fire anywhere is paid for by citizens everywhere.

Fire-resistive Partitions Between Adjoining Frame Dwellings. A building inspector in a small Southern city which requires by its building code a four-inch brick partition between party walls of frame tenements, reports constant pressure upon his office to waive this requirement on the ground that it is not essential.

This point is treated specifically in the publication "Dwelling Houses: Suggestions for their construction and fire protection" printed by the National Board of Fire Underwriters and distributed by the National Board's courtesy to National Fire Protection Association members.

It is believed that it is very essential that the partitions separating such buildings should be of incombustible construction, though not necessarily of brick. The above pamphlet contains recommendations for such partitions in rows of frame dwellings, and it ought also to be made to cover the partitions between twin houses.

The great danger of hollow partitions between adjoining wooden houses is that a fire occurring upon any floor is likely to break through into the hollow space and travel upward into the attics of both houses, thereby spreading the fire in places not accessible to fire streams. If the attic spaces are not separated by incombustible partitions which extend at least to the underside of the roof boards, a fire will spread with great rapidity through the space covering the whole row of houses thus connected. Such attic spaces are always filled with an accumulation of dust, and there is liable to be present sawdust and shavings left at the time of erection. This material will burn furiously, and in addition there is always likelihood of there being combustible material stored in such spaces. The necessity of having an incombustible partition extend through the ceiling of the upper story and through the attic space and made to join snugly with the roof boards is self-evident. Prof. Ira H. Woolson, Chairman, Committee on Fire-resistive Construction, National Fire Protection Association, reports recently hearing of a practice in one town of building these partitions as indicated and then for purposes of circulation of air through the attic space, openings about two or three feet square were made in each partition. The foolishness of this procedure needs no comment.

In the pamphlet referred to, it is recommended that every third partition in rows of such houses be made a solid wall eight inches thick to project at least two feet above the roof as a parapet. This construction is a very great safeguard in preventing the burning of a whole row of buildings, provided anyone of them should catch on fire. The cost of such partitions is not great and certainly should be insisted upon by every individual town government.

Where roof boards run across such partitions and there is a space between them, this space should be filled with mortar, otherwise the fire in one attic space will creep through into the adjoining one. The tendency of a fire to go through small holes of this character is greatly increased by the pressure of the air and hot gases produced by combustion in the confined space, and as such hot gases always rise the danger is greater next to the roof surface than it would be at the floor surface.

Combustible Finish in Dwellings. The increased cost of lumber has given an impetus to the manufacture of composition material from refuse bits of wood ordinarily discarded by the mills and wood working factories. This product, which bears a variety of names, varies but little in combustibility, and is finding a growing use for light partitions and as a substitute for plaster finish. It is obvious that its use may considerably increase the fire hazard of a dwelling, particularly if open draught passages are left behind it where used as sheathing. Fire Marshal Buckley of Ohio sends us a very grievous story of a fire in Akron, in a house finished with this material, in which E. W. Clark of 30 Oakdale Court lost two children, a girl of four and a boy of two. Chief inspector J. E. Jones, making the report, writes:

> The interior finish of the house being of Compo-board, which is very inflammable, the fire spread so rapidly that it was impossible for the mother to save her children. Mr. Clark awoke at 5:55, came down stairs, turned on electric lights and took a pail of hot water out to his automobile, which stood within 20 feet of his residence, to pour the hot water in the radiator. He had not been outside over five minutes when he discovered smoke coming from the window on the landing half way up the stairs on the east side of the residence. He rushed to the front door which was locked and broke the door and went inside and started up the stairs to rescue his family, but got no further than the third step when the maid rushed down the stairs and fell at his feet. He picked her up and carried her outside and then found it was impossible to go upstairs, so he rushed to the side window. His wife threw the two months old baby down to him and by this time the room was all in flames so she jumped from the window to save herself, leaving the two children in their bed. When the firemen got to the room they found them both dead.
>
> In our opinion if this house had been plastered instead of being finished with this Compo-board the fire would not have spread so rapidly and the fire department would have been able to save the children and the house.

In the opinion of the inspector the fire was caused by defective wiring, starting at the turning on of the switch by Mr. Clark and spreading rapidly behind the Compo-board sheathing while he was in the garage.

* * * * *

Sheet Metal over Wood Surfaces. It is because of the constant operation of the "dollar incentive", exerting itself against the common good, that most building inspectors prefer to have their regulations specific and not to be modified at their discretion. Even wise ordinances well established and long operative are often the subject of attack by special interests desiring to advance the sale of their products. There is an ordinance in force in Chicago which requires a coating of plaster or other incombustible material upon wood surfaces or wood construction before the application of stamped metal ceilings or sheathing. This requirement is common to many other building codes, since it has long been recognized that sheet metal offers little or no protection to frame construction against the attack of fire. In the interest of the sheet metal industry an attempt was recently made to amend the Chicago ordinance to permit the application of stamped metal without the first application of plaster or solid incombustible material.

The common experience of the fire chiefs of the country with metal ceilings and fires in concealed spaces under them has so well established the vulnerability of this sort of construction that any official tests have seemed unnecessary. A member of the National Fire Protection Association reports witnessing an informal comparative test, however, made for the purpose of information.

The test was an interesting one, though the test panels were not arranged in a way to make them all comparative. Two of them were quite large and four were quite small. The larger panels were approximately 8 by 14 feet in area, which was about four times the area of the smaller panels. For this reason, it would be unfair to attempt to draw definite conclusions from the results, but a few very conclusive facts were plainly evident; — one, that a metal ceiling backed with plaster board or with a layer of plaster, is far superior to a plain metal ceiling as a fire protecting construction. The panel which had ½-inch plaster boards covered with sheet metal showed a rise of temperature between the floor joists above the ceiling of 560 degrees F. at the end of 50 minutes, whereas the temperature registered in the same place in the same way above the metal ceiling without a backing was 600 degrees F. in 12 minutes, and 1,000 degrees F. at the end of 30 minutes, at which time the floor joists were burning freely. At the end of a 70-minute test, the floor joists to which the metal ceiling alone was attached, were almost entirely charred through at the middle, whereas the joists behind the plaster board and metal ceiling were only charred about 5 per cent. The two large panels were the sheet metal on joists without backing and plaster on wooden lath. The recollection of the member witnessing the test is that the latter began to collapse first, but the difference in the behavior between the two ceilings would be difficult to express. In his judgment, neither of these had much to recommend it as fire-resisting construction.

* * * * *

Zoning Laws in Cities. Referring to Mr. Ford's article in this issue of the QUARTERLY on the new zoning law now operative in New York City, a recent editorial in the *American Architect* is of interest:

The initial results of the regulations adopted by this city some four or five months ago restricting buildings of various classes to certain areas have undoubtedly been watched for with much interest by architects, owners and real estate operators. It is gratifying, therefore, to note that the effects thus far apparent seem to be entirely in accordance with the predictions of those who advocated the enactment of these restrictive measures. It is reported that in the Murray Hill section, considered one of the most desirable residential areas of Manhattan, there are now vacant, looking for occupants, only 60 per cent. of the houses untenanted when the zone law went into effect. Residences for many years vacant are now occupied, and some seventy-five are undergoing alterations at the present time preparatory to occupancy. The same effect can be noted in other localities belonging to the different classifications under the new law. Buildings on what had heretofore been retail streets, but which have stood vacant for a number of years, are being remodeled for tenants who can no longer look forward to the possibility of some time being able to locate in a residence district where their gain would be the neighborhood's loss.

Of course, the other side of the question is presented by owners who propose to ask for a reduction of their tax values in proportion to the possible loss of profits due to the zone

regulations. The owner of a lot, for example, who might have erected a sixteen-story structure, but who is now restricted to ten stories, is making application for a reduction in valuation of 40 per cent. Also, the owner of a comparatively low building in the vicinity of high buildings deems himself a sufferer by reason of the fact that he cannot build to the same height as his neighbors, and desires relief from this condition. At the same time, even those who claim to be injured by the operation of the new law, almost without exception admit that the measure probably will prove beneficial to the city at large and that injustice is only shown in certain individual cases. With this situation existing, there seems little doubt that even though attacks on the law may be made by selfish individuals, both its legality and desirability will finally be established and admitted by all.

There can be no doubt that in time each of the large cities of the country will be divided into zones restricted as to class of structure and occupancy. Such restrictions are absolutely essential if our cities, considered as a whole, are to be either beautiful or wholesome. Europe is far ahead of us in its municipal management, though here height-restriction ordinances are becoming more frequent, while zoning is not unknown. The restricted-district plan worked out in New York within the last two years and now effective is, of course, the most important step taken so far in the United States. Moreover, the conditions at New York were extremely complicated, so that no city in the country need fear to attack the problem on account of its complexity. In no other community in the United States will the factors found be so many and so involved. Chicago is now considering the matter. An ordinance is before the City Council which, if passed, will result in putting the matter officially before the legislature of the state.

* * * * *

Compulsory Sprinkler Installations. The constitutionality of the compulsory sprinkler ordinance of Chicago has not yet been passed on by the Supreme Court of Illinois. A number of cases have been won by the Chicago Fire Prevention Bureau in the lower courts, and bureau members have been expecting and hoping that some property-owner would appeal a case so that a ruling from the higher courts could be obtained and the bureau would know exactly what powers it possessed and would not be requiring some property-owners to do what others might later escape. Chief McDonnell of the bureau is confident that the ordinance would pass the test of the higher courts because its entire emphasis is on the protection of life, rather than the protection of property. A number of cases against orders for installation of automatic sprinkler systems are now pending in Chicago courts and members of the bureau are expecting that some property owner involved will appeal to the Supreme Court.

The ruling of the New York Board of Appeals, that the fire commissioner has no discretionary powers to order installation of automatic sprinkler equipment, should not be taken as an indication that New York City is taking a backward step in compulsory sprinkler legislation. Power to order installation still exists, but it can be exercised only when the commissioner is acting under definite rules and regulations prepared by the Board of Standards and Appeals.

There can be little question that after publication of the standards, which will be worked out by the Board of Standards, the compulsory sprinkler installation outlook in New York City will be much better than at present. The personnel of the Board of Standards and Appeals, of which Rudolph P. Miller (President, New York Chapter, National Fire Protection Association) is chairman, is such that one may be assured the standards adopted will be carefully considered and easily defended.

* * * * *

Retired Firemen as Inspectors. One of the hardest tasks a fire chief ever has to face is the laying off of firemen who have served the department long and well, but who because of injuries or age can no longer haul heavy hose lines into buildings or do other things required of efficient men. Chief Thomas A. Clancy, of Milwaukee, in a recent letter to the National Fire Protection Association says:

> At the present time we have forty members doing inspection work daily, in addition to their regular fire duties. We also have seven men in charge of a Captain who do special inspection work. These men are members of the department who have been injured in service and would be of very little use for active fire fighting, but on the other hand make first class inspectors, on account of having from ten to thirty years' fire experience. It is a far better plan, in my opinion, to detail these men for fire prevention work, than to pension them off and compel them to seek other positions in order to gain a livelihood.

Chief Frank Henderson, of St. Louis, has made exceptional efforts during the past year by planning entertainments and other revenue-producing affairs, to increase the pension fund of his department to a point which will allow the bare necessities of life to the men efficiency demands must soon be laid off.

The chief of a metropolitan fire department has a big enough job without carrying on his mind and heart the economic welfare of men the city itself should provide for. Chief Clancy's plan is certainly a sensible one so far as it is practicable. The older heads should be superior in both wisdom and tact, necessary attributes for a good inspector.

* * * * *

Defective Fire Fighting Apparatus The Pennsylvania Department of Labor and Industry reports the finding by its inspectors throughout the State of many establishments wherein fire fighting equipment is unfit for service. The Department deplores the feeling prevalent that equipment of this kind if once placed in position will not need attention until a fire occurs in the establishment. As a result, in many cases when a fire does occur and employees try to use the equipment which is furnished, they find that it is unserviceable.

In one establishment a fire had occurred three weeks before the time of the inspector's visit. He found half a dozen of the chemical type of fire extinguishers in the establishment that had not been recharged since the fire. These extinguishers had been used very effectively in fighting the fire. But for them, the fire might have destroyed the establishment.

Notwithstanding the great service they had rendered, no attention had been given them since the fire. They would have been absolutely useless in the case of a second fire.

One inspector of the Department found over one hundred fire extinguishers inoperative or useless in the various establishments which he visited during a single month.

Inspection has also revealed the fact that much fire hose has been in position for such a long time, or has been used for other purposes, that it has rotted, and would be unserviceable if water should be turned into it. In some cases, the hose had been removed entirely, and its absence had not been noted until the attention of the management was directed to this fact. In other cases the nozzle was found to have been removed, and could not be found.

In a special bulletin on this subject, the Department points out that apparatus of this kind, to be of any value, must be ready for instant use. The original cost of this equipment is comparatively high, and, if it is not properly maintained, is a total loss to the owner; not only that, but the factory itself is at the mercy of any fire through a false sense of security.

* * * * *

Unusual Cause of Fire Hose Failure. Fire hose frequently fails as the result of poor care; linen hose rots if allowed to remain wet and cotton rubber-lined hose goes to pieces from excessive dryness which cracks the rubber tube; but Mr. James E. Latta of Underwriters' Laboratories, reports a case of hose failure under test that is unusual in our experience.

Not long ago a certain industrial concern purchased about a thousand feet of millyard hose from one of the large manufacturers in whose plant Underwriters' Laboratories Label Service is regularly employed. The hose made a satisfactory showing under factory tests, the usual tests and inspections being made; but on a pressure test at the factory of the purchaser a few days later, three lengths burst at pressures that should have been permanently withstood. At the time of this test the hose had not been used. The pressure had been kept on half an hour or so when the first rupture occurred, followed a few minutes later by the bursting of two more lengths. It was asserted that the tests had been properly made and the hose not abused. However, an inspector from the factory who went to witness the tests on the three lengths sent to replace those that had failed noticed that the jackets of most of the original order were badly chafed and weakened. Two of the three lengths furnished for replacement and two of those sent at first were siamesed on a double hydrant and a pressure of about 100 pounds per square inch established. Careful inspection made at this time disclosed the fact that the pulsations of the pump were causing the hose to oscillate considerably in a longitudinal direction and that the constant grinding of wet cinders, which, over a radius of 50

feet around the hydrant, constituted the ground surface, was rapidly wearing the hose jackets away. This was evidently the explanation of the failures reported.

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Locating Forest Fires. Readers of the QUARTERLY will remember the recent interesting article by member Niles Searls, General Fire Inspector of the Southern Pacific railway, on methods of locating fires in the vicinity of the snow sheds of the company. W. B. Osborne, of the Portland office of the U. S. Forest Service, has invented an instrument which by a single observation projects the site of a forest fire on a topographic map.

This "finder" was used with success last summer by the 125 lookout men in the national forests of Oregon and Washington and located fires in a few minutes without the necessity of waiting until a second course upon it is reported from another station. It consists of a metal plate 24 inches in diameter, bearing a topographic map of the country visible to the observer. On the outer edge of the map a graduated circle is laid out. The instrument is securely mounted and the map oriented so that the true bearing may be read from the graduated circle on the outer edge of the topographic map. To the center of the plate an alidade is pivoted, consisting of a straight edge and two sights. The plate and alidade may be mounted on a short track, which permits sliding the plate when necessary to avoid a post or window frame in sighting a fire. A simple vertical vernier is attached to the sights, so that the vertical angle of the fire under observation may be determined.

When a fire is discovered the lookout man turns the alidade and reads the true bearing of the fire from the graduated circle, after which the vertical angle is also noted. By referring to the topographic map it is also possible to draw a profile map of the country along the line of sight. Then, by drawing the line of sight as indicated by the vertical angle, the profile is cut at the point at which the fire is burning.

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The Forest Beetle and the Forest Fire. Writing as "a champion of conservation" and "a friend of the Forest Service", Stewart Edward White in the *American Lumberman* of 9th December, 1916, enters a plea for the forest fire. He says, in an article entitled "The Tree-Killing Beetles of California and Possible Remedies": —

> The writer must repeat: He is a champion of conservation, a friend of the Forest Service, an admirer of the spirit of the men in that service. But as regards fire protection, the Forest Service is riding to a fall. Temporarily it is keeping out all fire; it is building the material for conflagration which can by no possibility be controlled; it is encouraging epidemics. Lumber slashings, extensive as they were, never bred epidemics. Only with unchecked accumulation have the beetles become a scourge. In short, the Service is arranging for the destruction of more trees than it saves. Its heads have not thought far enough. They have realized the destructiveness of fire thoroughly; they have not even considered the

uses of fire, or they have considered those uses only through the lenses of preconceived theory; They have taken away the wild, lawless, often destructive, but finally essential forest cleanser. they have provided no orderly, well trained substitute.

So, too, we have heard other champions of conservation explain how the medical profession had "realised the destructiveness" of smallpox thoroughly but in taking away that "wild, lawless, often destructive, but finally essential cleanser" of the human system, they had provided no "orderly, well trained substitute" which should duly weed out the weaklings and clean the systems of the strong. There is nothing like a conflagration for getting rid of slums and fire-traps which city ordinances and public opinion might have tolerated indefinitely. Recklessly driven automobiles have a wonderful influence in promoting sprightliness of limb and watchfulness of eye — and yet! No, Mr. White, all that you say about the tree-killing beetles may be true, but your argument is essentially reactionary. The policy of playing off one evil against another is open to the very criticism you level at the Forest Service for not having "thought far enough". We do not think so poorly of the possibilities of man as to suppose that he can only overcome the forest beetle by slackening his attack on the forest fire. The human animal is fit for a better part than that of balancing the relative advantages of allying himself with the beetle against the fire, or with the fire against the beetle. His job is to find some means of vanquishing both the beetle and the fire.

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Where Angels Fear to Tread. Our Salem, Massachusetts, member, Mr. C. P. Faunce, whose extensive reading has in a number of instances furnished the Association with delectable bits of naive journalism, has placed in our hands a page of the *Woman's Home Companion* issue of April, 1915, containing an article by Mae Belle Savell on "Practical devices for increasing comfort that should be included in your new home."

This is an extract from the article:

> While in a few completed houses the dumb-waiter may find a place for itself where it can run through from the cellar to the top floor without interruption, it is rare that a ready-built house can be found affording space in the proper places. The value of this old-fashioned labor-saving device cannot be exaggerated. Instead of carrying up the many, many things that daily have to come from the cellar, they are placed on the dumb-waiter. No energy is wasted, and one trip will save three. It serves the place, also, of the more modern linen chute. The linen chute is not to be tabooed, for it has its uses, but it is practically wasting space to have both it and the dumb-waiter. In many houses the dumb-waiter stops short at the second floor — the reason why has never been discovered; or sometimes it starts at the first floor instead of in the cellar — another enigma. This is as impractical as it would be to have the sidewalk end before it reaches the house. It simply doesn't answer the purposes for which it was intended.

Mae Belle Savell's suggestion might be called "An aid to the fire department in locating the right house." Houses equipped as she suggests are habitually identified by flames breaking out of the roof a minute or two after a fire starts in the basement. Sometimes, however, lives of women

and children are sacrificed to the "comfort" of the open draught-ways Mae Belle Savell advocates. The fire prevention editor of the *Woman's Home Companion* may have been playing golf the afternoon Mae Belle Savell's copy went through. Or perhaps the *Woman's Home Companion* hasn't any fire prevention editor.

* * * * *

Water Waste in Chicago. City Engineer John Ericson, of Chicago, Ill., in his report for the year 1915, included in the report of the Department of Public Works, calls attention to the large waste of water in that city and urges that it be stopped, recommending the liberal installation of meters. Mr. Ericson realizes the advantages of showing the significance of this waste in striking figures. He says:

> Of the total amount of water pumped a conservative estimate places the waste through leaky fixtures, wilful wastage and underground leaks at 50 per cent. In order to illustrate what this leakage represents, if it could be all eliminated, it may be pointed out that four out of nine major pumping stations would be unnecessary, reducing the expense about $700,000 a year. This does not take into account the greatly reduced cost of tunnel construction. The water wasted each day fills the capacity of eighteen 36-inch cast iron pipes flowing simultaneously at a velocity of three feet per second, or the equivalent of eleven 25,000,000-gallon pumps working twenty-four hours a day. The total amount of coal used in 1915 would make 38,760 five-ton wagon loads, and if the wastage could be eliminated 19,380 wagon loads of coal burned could be diverted to some useful purposes.

These are striking facts. That water waste is also a waste of coal escapes the ordinary observation. There is no limit to the profligacy of the American people in respect to the gifts of nature.

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More Water for Greater New York. The Department of Water Supply of Greater New York expects that by April 1 the new Catskill aqueduct will be in use throughout its whole length and that thereafter Catskill water will be brought to the city at the rate of over 300,000,000 gallons a day. In view of the present shortage of water in Brooklyn, due to the greatest period of drought recorded since 1825, strenuous efforts are being made to put in use by January 1 that portion of the new Catskill aqueduct which runs from 93d street, Manhattan, to Brooklyn, so that pending the arrival of the Catskill water the department may relieve the Brooklyn situation somewhat by sending there a limited amount of Croton water. But even then water must be used in Brooklyn with very great caution, unless indeed heavy rains should come to fill the depleted Brooklyn reservoirs.

THE FOREST PLEADERS

Recitation for Six Pupils, designed for Fire Prevention Day or Arbor Day.

By E. T. Allen.

First Pupil:
(carrying evergreen branch)

I AM THE FOREST.
I clothe this western land
With beauty and on every hand
You turn to me in daily need.
Your best friend I have always stood;
You could not live not using wood.
For your protection now I plead.
Nor do I bid you take my word;
Let these my witnesses be heard.

Second Pupil:
(carrying pail of water)

I AM THE STREAM.
From my woodland springs
To river mouth where the white gull wings
Over the ships from the ends of the earth
I flow to your homes and mills and fields
And carry the freight that the harvest yields,
But shady forests gave me birth.

Third Pupil:
(carrying pet animal)

I AM THE WILD THINGS.
I speak for graceful deer
And flashing trout in brook pools clear,
For singing birds and squirrels pert,
And all the wearers of feather and fur.
What should we do if no forests were
To shelter us from fear and hurt?

Fourth Pupil:
(carrying axe)

I AM THE WOODMAN.
To me the forest brings
Reward for labor and all things
That money buys, for in my state
Over half our wage-earners' pay
Comes from lumbering in some way.
The fate of forests is my fate.

Fifth Pupil:
(carrying fishing-rod)

I AM PLEASURE.
Happy vacation days,
Camping, hunting, and all the ways
Of nature in her gladdest moods,
The forest holds for girls and boys
Who love out-doors and wholesome joys.
There is no play-ground like the woods.

Sixth Pupil:
(strikes match and holds it burning)

I AM THE FUTURE.
Shall all these pass away?
Must we look forward to a day
Of fire-charred, lifeless, streamless slopes
Where thoughtless match or unwatched brand
From man's ungrateful, careless hand
Has destroyed his children's hopes?

All:

FIRE IS OUR ENEMY.
Won't you help us then?
Learn yourselves, and teach all men,
This, the lesson all must learn:
Put out the campfire and the match;
Careful with slash and clearing-patch;
Leave no fires in the woods to burn.

(*Future*) blows match out, watches as he drops it, then tramps it out)

Loss of Animal Life by Fire.

By W. T. Colyer (Member N. F. P. A.)

The law printed below has just come into effect in the State of Massachusetts:—

An Act to Require Fire Protection in Stables for Horses and Mules.

Section 1. No horse or mule shall be stabled on the second or any higher floor of any building unless there are two means of exit therefrom, at opposite ends of the building, to the main or street floor.

Section 2. This act shall not apply to stables equipped with an automatic sprinkler system.

Section 3. Any violation of this act shall be punished by a fine of not more than two hundred dollars.

Section 4. This act shall take effect on the first day of January, in the year nineteen hundred and seventeen. (Approved April 26, 1916.)

According to Dr. Francis H. Rowley, President of the Massachusetts Society for the Prevention of Cruelty to Animals, this is the first legislation of its kind in the United States, and, indeed, so far as he is able to ascertain, in the history of humanity. The urgent need for such an enactment was impressed on Fire Prevention Commissioner John A. O'Keefe and Dr. Rowley, who jointly deserve the lion's share of the credit for the new law, by a series of harrowing fires in the neighborhood of Boston, in which many horses were burned alive in stables from which rescue was impossible. The *Boston Herald*, the editorial columns of which are honorably distinguished by the frequent appearance of articles on various aspects of the fire waste, did good work in giving publicity not only to the fires which actually occurred, but also to the hazardous conditions under which horses were regularly stalled in congested parts of the city. In some cases it appeared that thirty or more horses were kept on second,

third, or even fourth floors of buildings with unprotected wooden chutes and central air shafts but only one exit — a winding runway covered with chaff or ragged canvas.

This aspect of the fire waste is one which appeals much more readily to many people than does the broad economic aspect. However misguided such an opinion may be, thousands of quite intelligent and, on the whole, fairly public-spirited citizens feel a certain lordly magnanimity in pooh-poohing the fire problem; they find a sort of perverted satisfaction in the thought that the country can afford such a loss, and one occasionally meets the argument that fires are good for the building industry and increase the opportunities for experiment in city-planning. On the other hand, by no stretch of imagination is it possible to indulge in pleasing illusions about magnanimity when we are simply careless of the suffering of other sentient creatures. Speaking generally, the emotions aroused by reading of such happenings as the breaking of a horse's legs in its attempts to escape by jumping from the firetrap in which it was stabled, or the sight of rescued horses rushing about half-mad with the pain of their burns, are different only in degree from those aroused by some holocaust in factory or school. The dictum of the veteran automobilist, to the effect that the only way for a beginner to make reasonably sure that he will not in the future endanger human life by reckless driving, is to resolve from the start to ruin his tires rather than run over so much as a chicken, has its application to the fire problem. Brutal disregard of the safety of animal life from fire is not far removed from brutal disregard of the safety of human life; and it is not difficult to get general assent to this proposition. Public opinion is probably more than ready for any legislation that is likely to be put forward along these lines.

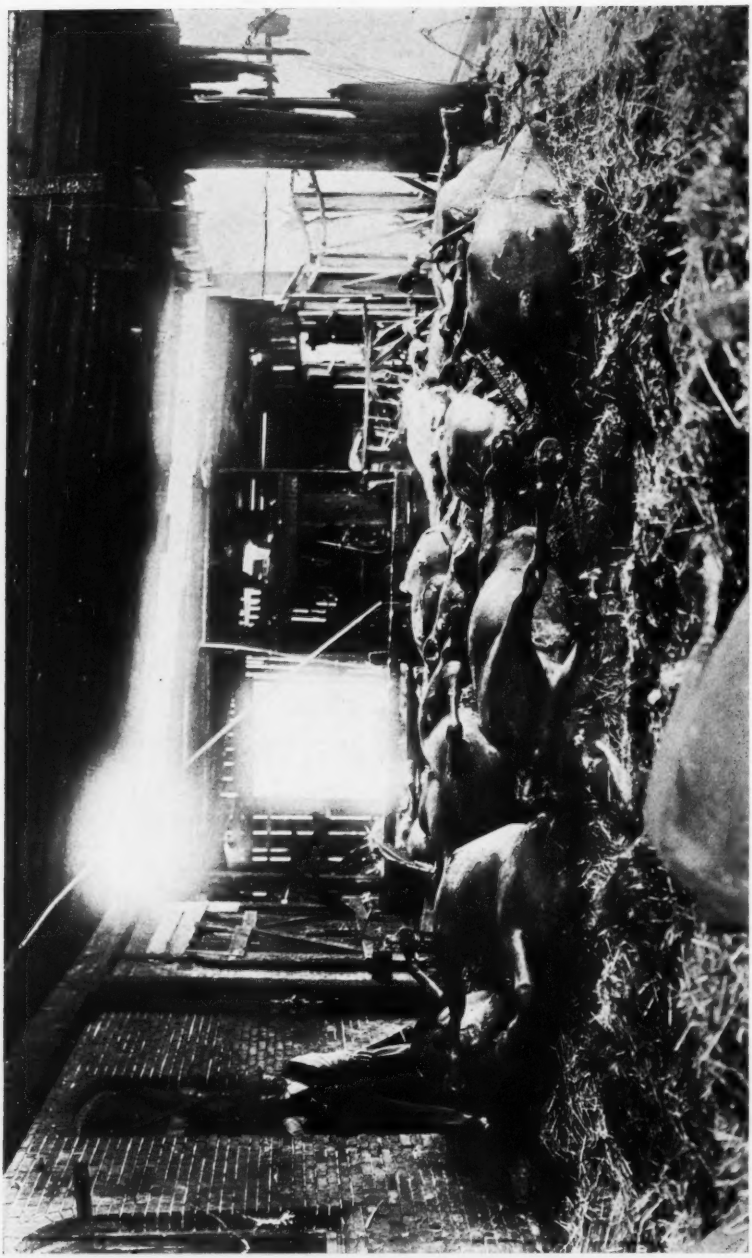
From the fire-preventionist's point of view everything that brings the fire hazard prominently under public notice and compels reasonable precautions in any direction has a distinct value for the whole campaign; and, therefore, to put it on no higher ground, this question of protecting animal life should be of interest to those who are fire preventionists primarily on economic grounds. The installation of sprinklers, or the provision of additional exits for horses and mules as now required in Massachusetts, will, of course, help to protect other values than the animals for whom the additional protection is designed, but even as a purely financial proposition there is a good deal more to be said for the protection of the lower animals than is generally realized. Since the writer's thoughts were set working along these lines by reading Commissioner O'Keefe's circular letter to stable owners, he has taken some pains to obtain data regarding the loss from this cause. The *American Society for the Prevention of Cruelty to Animals* has no statistics or special information on the subject, though it appears that its attention is frequently drawn to the fact that "practically no effort is made to properly safeguard animal life in barns and stables." Hitherto the Society seems to have been at a loss how to proceed to secure better conditions. It has, however, arrived at certain conclusions as to the requirements which should be insisted upon "by all

humane persons who understand the subject"; and it may be of interest, before taking up considerations of dollars and cents, to indicate briefly what these requirements are.

Where large numbers of horses are kept, the Society is of opinion that more than one runway, and, if possible, an exterior runway, should be provided. Quick tripping devices should be installed whereby animals can be instantaneously released from stall fastenings, either manually or by electrical current. Adequate watchman service and auxiliary fire-fighting devices such as pails, extinguishers, hooks, axes, etc., should be available; attention should be given to the width of doors and passageways with a view to guaranteeing safe exit, and a sliding skylight system should be provided at the roof to permit smoke, superheated air and explosive gases to escape from the building in time of fire, and so as to prevent back draught and mushrooming. These requirements apply to large stables, but the Society considers that, where the number of animals is small, simple locking and unlocking devices should be provided and sufficient runways between floors should be installed. It should surely be possible for the Society, now that a beginning has been made in Massachusetts, to undertake an agitation for the enactment in other states of fire-protective laws along the lines it has sketched out.

To return to the question of the extent of the loss. Day by day the writer watched the columns of the New York *Journal of Commerce* for fires involving the burning of animals. He discovered some 80 fires in this class occurring during the eight weeks from 26th October to 20th December, 1916. The victims included more than 300 horses and mules, nearly as many head of cattle, not less than 200 pigs, more than 30 sheep, probably 1,000 head of poultry at least, to say nothing of such odd items as 4 goats and 200 pigeons. The figures cannot be given with precision; owing to the not infrequent use of such terms as "several," "a number," and, in the case of the poultry, even vaguer expressions. There were no fires of great magnitude included in the record kept, and taking it as a basis for rough calculation, we find a yearly toll of nearly 2,000 lives for horses and mules, of about the same number for cattle, of between 6,000 and 7,000 for poultry, and of something like 1,300 for pigs. It need hardly be said that large quantities of feed, agricultural implements, wagons, and other valuable property were destroyed at the same time as the unfortunate animals. In many cases, no doubt, the buildings were of comparatively small value, but it seems fairly safe to suppose that, if more attention had been given by their human masters to the rights of the domestic animals to be spared unnecessary suffering, a large saving of property of other kinds would incidentally have been effected.

Another consideration of some slight importance on the financial side is that of placing difficulty in the way of the incendiary. An ugly feature connected with the fires involving the destruction of animals is the frequency with which they are known or suspected to be of incendiary origin. Plenty of corroborative evidence of this is available outside the columns of the *Journal of Commerce*. Chief Frank E. Henderson, of



Interior of corral at St. Louis after fire suspected to be of incendiary origin.

At the rear of this office was the corral in which 27 horses were burned to death.

St. Louis, not so long since, broke up a gang of ruffians who systematically burned horses for profit. Their plan was to insure a valuable horse and in due course to set fire to its stable. Before this was done, however, a sorry old nag was quietly substituted for the insured animal; and the full amount of the insurance was subsequently collected on the evidence of the charred corpse. The valuable horse was taken to another district and again insured with similar consequences. To the courtesy of the same redoubtable officer we are indebted for the photographs accompanying this article and showing a horrible fire in which a number of horses were burned under most suspicious circumstances.

Chief Henderson says:

"I did not respond to the box from which the alarm was struck, but was called by the Battalion Chief in charge, on account of the strong smell of gasoline detected by him.

"The picture of 27 horses lying dead, with partly cooked bodies, the flesh hanging in shreds, was a ghastly sight to behold. However, the peculiar thing about this whole affair was the fact that no one in the neighborhood could be found, who heard the animals emit the faintest kind of a sound. This indeed seemed strange to me, for I have seen a number of horses burned to death, and they make the most heart-rending cry for help.

"It is alleged that a man rented this corral for the purpose of gathering a car load of horse to ship south; he succeeded in buying 27 head — and insured the bunch for $100.00 per head, and soon after the fire occurred, with the result shown in the picture.

"The alleged owner was arrested and held for the Grand Jury, but that body did not think there was sufficient evidence to warrant his being held."

View of corral in which 27 horses were burned.

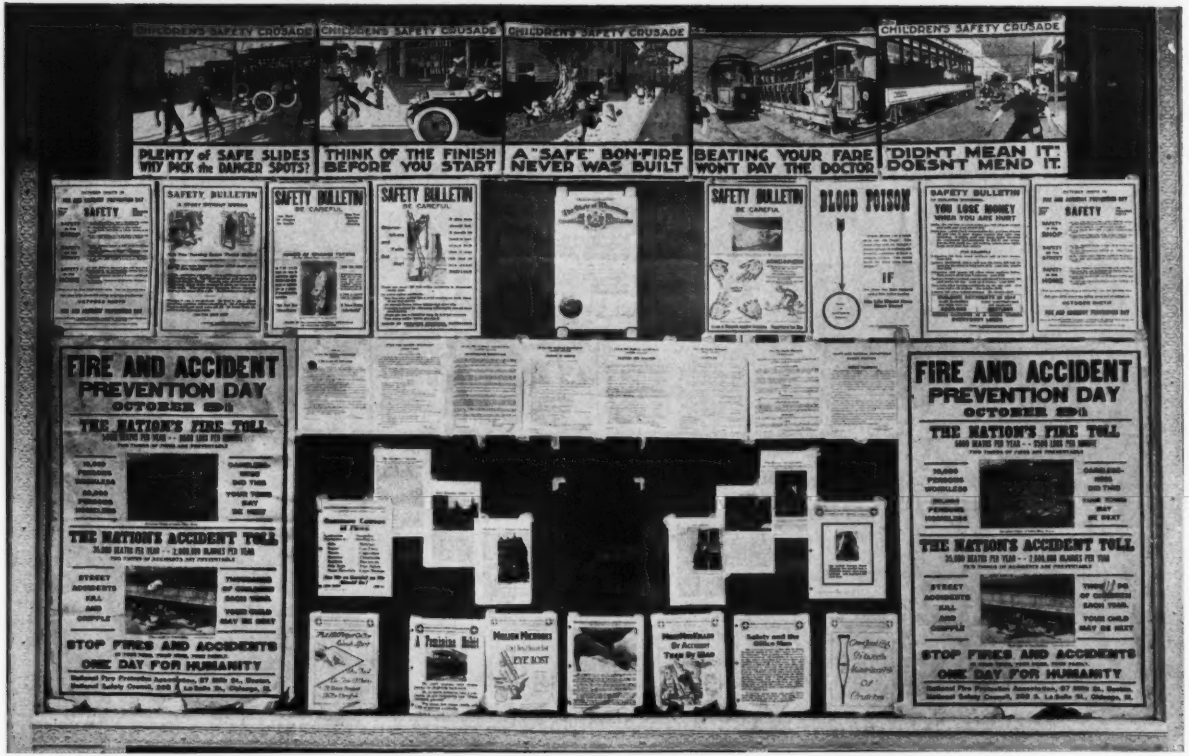
St. Louis is certainly not the only city in which such things occur. Somerville, Mass., for example, has been the scene of a series of incendiary fires set with a fiendish cruelty which seems to have been absent in the St. Louis case — if, as the Chief thinks possible, the horses were drugged in advance.

No article dealing with any aspect of the American fire waste is complete without some reference to European conditions. So far as the writer has been able to ascertain, the loss of animal life by fire in Europe is comparatively small, the bulk of such loss as there is being attributed mainly to lightning striking the cattle while grazing. This is the more remarkable when it is remembered that farm property is not regarded with favour by the fire insurance companies, at any rate in England and Germany, on account of the moral hazard. Rick burning has been a traditional method of settling grudges both personal and political, and it is practically impossible to exclude the hazard arising from the recklessness or malevolence of the occasional tramp who will find a night's lodging under the shelter of the rick. Moreover the moral stamina and intelligence of the agricultural workers have been steadily deteriorating under the strain of constant emigration by the more energetic and independent spirits either to the cities or to the newer lands across the seas; and where there exists an unorganized laboring population living under intolerable conditions — economic, social, political and moral — in the midst of easily

burnable property, incendiary blazes are not surprising. The reasons which preserve the livestock from the effects of this general moral hazard appear to be two: (1) the much less extensive use of wooden structures for all purposes in Europe, with the result that, even when buildings are set on fire, they burn less rapidly and there is more opportunity to rescue the inmates, (2) the practice of taking out life insurance on the live stock on a very much larger scale than seems to obtain in the United States. This latter practice, involving periodical veterinary inspections and carrying with it an obligation to pay attention to the sanitary conditions under which the animals are kept, no doubt automatically compels a standard of housekeeping which materially reduces the fire hazard from uncleanliness and untidiness.

It is by no means clear that in England at any rate carelessness which led to the unnecessary burning of a domestic animal would not be criminal carelessness. The terms of the Protection of Animals Act passed in 1911 are extremely wide; any act whether of commission or of omission which causes any domestic or captive animal "unnecessary suffering" is an offense of cruelty under the Act; and it is further provided that any owner who fails to "exercise reasonable care and supervision in respect of the protection of the animal" from cruelty shall be deemed to have "permitted" cruelty, such permission being made punishable under the Act.

It may be that there are laws already in existence in some States in this country under which it might be possible already to do something to save animals from burning. The suggestion is offered to the Societies for the Prevention of Cruelty to Animals that they look into this question. They may confidently rely upon receiving the support of fire-preventionists in any attempts they may make to reduce the suffering of animals from this cause, and they may have the additional satisfaction of knowing that they are incidentally helping a movement which aims at nothing less than the reduction to a negligible quantity of the tremendous volume of the suffering — indirect as well as direct, human as well as animal — that now results from the unnecessary destruction by fire of life and the means of life.



PHOTOGRAPH OF WINDOW DISPLAY ARRANGED AT MADISON, WIS., FOR FIRE PREVENTION DAY.

Bulletins of the Industrial Commission of Wisconsin and the State Fire Marshal, with posters issued by the National Safety Council and the National Fire Protection Association, grouped around the Governor's Proclamation. The black square beneath the Proclamation represents one of the "No Smoking" cards of the National Fire Protection Association.

More About Fire and Accident Day, 1916

There are at least two good reasons for drawing our members' attention once more to the "fire and accident" exercises of 9th October last. The first reason is that a good many fresh reports have come to hand since our first article on the subject went to press. The second is that we are glad of an opportunity to remind all of our readers whom it may concern, that now is the time to begin to plan the celebration of 9th October, 1917. The story issued by the Rochester Chamber of Commerce must have made abundantly clear to our other members how great an expenditure of preliminary thought and organized effort is necessary to a thoroughly satisfactory celebration; and work of this kind is not limited to corporate bodies. According to our contemporary, *The Insurance Post*, many instances were brought to its notice in which some wide-awake and public spirited individual was successful in "transforming what would have been a perfunctory observance into an effective and result-getting affair." There is plenty of room for activity of this sort, and we should like to see an honorable emulation among our members, where they have opportunity, to achieve individual preëminence in this line of service.

Turning to the new reports, we find that fine work was accomplished in Portland, Oregon, by Fire Marshal Jay W. Stevens and the local Association of Credit Men. A practical and attractive fire prevention bulletin was disbributed by the thousand; appropriate exercises were held in the schools; in the morning there was a display by the fire boats on the river, and in the afternoon the firemen performed spectacular stunts on land: a parade more than a mile long was organized with the co-operation of civic bodies and public departments of all kinds. It is also claimed that as a result of the efforts of the fire marshal the preachers in all of the churches in the city delivered sermons on fire prevention as applied to the life that now is. Tacoma is another of the Western cities concerning which detailed information is to hand. Effective use was there made of the public school Safety Scouts, an organization of girls and boys associated in the interests of general safety observances. Over 1,000 of the scouts took part in the Fire and Accident Prevention Parade, carrying signs inscribed with various devices.

Much more than ever before was done to popularize the idea of fire prevention in the southern states. The improvement seems to have been particularly marked in the case of Georgia, but much good work was done elsewhere. More than fifty blocks in the mercantile section of New Orleans were thoroughly inspected. In Birmingham, the fire pre-

ventionists, though they were doomed in the present to fight a losing battle over the wooden shingle ordinance, were able to carry their gospel into the schools and so lay the foundations of a better future. In Texas the efforts to interest business men seem to have been especially successful. Only one town in Kentucky — Owensboro — is reported as having organized anything in the nature of a general celebration, but the success there was such that plans have already been set afoot looking toward a state-wide celebration this year.

A very unusual fire prevention display in the City Hall at Newark, N. J., attracted so much interest that it was continued for a week, although originally intended for show on Fire Prevention Day only. Under the direction of our member, Captain C. Albert Gasser, a comprehensive collection of exhibits was gotten together and strikingly arranged to illustrate almost every class of fire hazard. Wherever practicable relics from actual fires were used to drive home the desired lessons. In the City of New Haven a very interesting experiment is in progress. A Junior Fire Prevention League has been formed from the seventeen schools in which there are grammar grades. The principal of each school selected ten boys of good character and reputation for leadership to be assistants to the fire captain of the district in inspection of premises. It is the duty of these lads to report violations of the fire ordinances, and any conditions, such as the accumulation of rubbish, which may tend to cause fires or to impede the work of the firemen in the event of an outbreak. October 9th was selected as the day on which the boys should be decorated with the metal badge of the League, and the ceremony was made an occasion for uniformed firemen to address the pupils on the subject.

Even with the additions now made, we do not claim that our record is in any sense exhaustive; but we believe it is fairly typical. Our information is at any rate sufficient to show that the tide of public sentiment has begun to flow in the direction of fire preventive work. Newspapers, associations of business men, women's clubs and civic organizations of all kinds are becoming interested; and we believe that upon our members to a great extent devolves the responsibility for seeing that the newly awakened enthusiasm shall not wear itself out for lack of intelligent guidance and leadership.

1916 Fire Losses $231,442,995.

The losses by fire in the United States and Canada during the calendar year 1916, as compiled from the carefully kept records of *The Journal of Commerce* and *Commercial Bulletin*, aggregate $231,442,995. These figures are severe compared with the annual average and are nearly fifty millions ahead of 1915, when the losses reached a total of $182,836,200. The losses for the year just closed were only exceeded six times in the history of the country, and were largely contributed to by heavy losses in the South and in Canada, besides which

the Black Tom Island explosion and fire in New York harbor accounted for $11,000,000 of the total. Higher values of almost all classes of commodities undoubtedly had a material influence in swelling the total fire losses.

There were, aside from the Black Tom Island disaster, three fires of the nature of general conflagrations, and they were all in Southern States. These conflagrations were at Paris, Texas, causing a loss of $7,000,000; at Augusta, Ga., causing a loss of $5,000,000 and at Nashville, Tenn., causing a loss of $1,500,000. The latter fire sharply emphasized the hazard of shingle roofs. The Canadian losses were heavy, mainly due to the destruction of several large individual risks, including the Canadian Parliament building with a loss of $3,000,000 and the oat meal mill at Peterboro with a loss of $1,500,000, but on the former loss fire underwriters escaped, as the Government buildings were not insured.

The war munition hazard was again a contributing factor to the country's heavy fire losses, as there were numerous losses in plants of this character, some of them being of considerable value. These fires include the Black Tom Island disaster, the Tennessee Copper Company's plant at Copper Hill, Tenn., and the munitions dock and steamers at Brooklyn.

The movement for national fire protection has not lost ground during 1916, notwithstanding the heavy losses, and legislation as far as it has gone has been along the lines of stimulating greater interest of the public in regulations and laws that will prevent fires. Political factions in all States have shown a broader view as to the value of such legislation and are favorable to the passage of laws that will restrict the country's excessive fire waste.

The aggregate fire waste of the United States and Canada during the past forty years from 1877 to 1916, inclusive, reaches the enormous total of $6,251,165,220, showing an annual average property destruction of $156,279,130. This vast drain upon the country's resources continues to show a gain, notwithstanding the efforts of the fire preventionists. The value of property destroyed during the past forty years constitutes a serious drain upon the nation's resources. That this drain is uncalled for is shown in the data as to origin of fires which indicate that a very large percentage of the fires are from preventable causes. The following table, giving the losses by years during the past forty years, shows, despite an occasional decrease, the tendency is generally upward in the aggregate loss, but this may be accounted for in the larger values of the property exposed to the fire hazard:

FIRE LOSSES DURING PAST FORTY YEARS AGGREGATE $6,281,260,220.

1916	$231,442,995	1896	$115,655,500
1915	182,836,200	1895	129,835,700
1914	235,591,350	1894	128,246,400
1913	224,728,350	1893	156,445,875
1912	225,320,900	1892	151,516,000
1911	234,337,250	1891	143,764,000
1910	234,470,650	1890	108,893,700
1909	203,649,200	1889	123,046,800
1908	238,562,250	1888	110,885,600
1907	215,671,250	1887	120,283,000
1906	459,710,000	1886	104,924,700
1905	175,193,800	1885	102,818,700
1904	252,554,050	1884	110,008,600
1903	156,195,700	1883	110,149,000
1902	149,260,850	1882	84,505,000
1901	164,347,450	1881	81,280,000
1900	163,362,250	1880	74,643,400
1899	136,773,200	1879	77,703,700
1898	119,650,500	1878	34,315,900
1897	110,319,650	1877	68,265,800
Total for forty years			$6,251,165,220

The losses by fire during 1916, when considered by months, show the usual decrease during the summer months, with the exception of July, which was increased by the Black Tom Island disaster. March was exceptionally heavy as a result of the three Southern conflagrations. The following table affords a monthly comparison of the losses during the past three years — 1914, 1915 and 1916:

	1914	1915	1916
January	$23,204,700	$20,060,600	$21,423,350
February	21,744,200	13,081,250	24,770,770
March	25,512,750	18,786,400	38,680,250
April	17,700,800	18,180,350	12,681,050
May	15,507,800	11,388,450	15,973,500
June	29,348,000	10,893,950	12,247,500
July	17,539,800	9,006,800	23,013,800
August	11,765,650	10,067,100	10,745,000
September	14,383,050	14,823,500	12,244,625
October	14,004,700	14,465,850	17,701,375
November	21,372,750	21,204,850	19,898,450
December	23,507,150	20,877,100	22,063,325
Total for year	$235,591,350	$182,836,200	$231,442,995

There were no less than 2,857 fires during 1916, which in each instance caused an estimated property damage of $10,000 or over. This compares with 3,152 such fires in 1915 and 3,502 fires of a similar magnitude in 1914. The following table giving the monthly record of the fires of $10,000 or over during 1916, classified according to their destructiveness, will be found of interest:

	$10,000 to $20,000	$20,000 to $30,000	$30,000 to $50,000	$50,000 to $75,000	$75,000 to $100,000	$100,000 to $200,000	$200,000 and over	Total
January	127	78	34	38	16	34	22	349
February	91	61	44	23	8	36	17	280
March	97	46	34	32	14	27	28	278
April	56	45	21	30	10	18	11	191
May	65	42	19	35	12	21	21	215
June	49	26	21	18	8	18	10	150
July	54	34	19	28	6	18	10	169
August	68	39	38	21	9	20	7	202
September	84	50	34	31	7	23	7	236
October	66	43	35	31	8	25	24	232
November	89	44	38	33	14	40	23	281
December	95	43	34	31	12	31	28	274
Totals	941	551	371	351	124	311	208	2,857
1915	1,198	590	413	375	138	291	147	3,152
1914	1,233	667	485	406	182	336	193	3,502
1913	1,298	695	492	416	182	355	184	3,622
1912	1,278	689	514	433	162	396	168	3,640
1911	1,159	596	525	402	178	352	189	3,401
1910	1,098	594	450	371	196	324	192	3,225
1909	1,128	570	457	444	174	337	160	3,270
1908	1,644	754	587	407	192	339	145	4,068
1907	1,671	764	547	420	209	299	154	4,064
1906	1,399	663	477	360	163	252	125	3,439
1905	1,326	657	502	367	152	258	101	3,363
1904	1,180	595	482	328	173	233	106	3,097

New York's New Zoning Law.

How New York City Now Controls the Development of Private Property.

By George B. Ford.

Consultant to the Commission on Building Districts and Restrictions.

The city government of New York has put into effect by a virtually unanimous vote of the Board of Estimate and Apportionment the radical and much talked of Zoning Law. All future buildings will be restricted as to their height, size and use and the restrictions will be different in different parts of the 327 square miles of the city.

Hon. George McAneny, the father of the law, said: "It is the greatest thing the city has ever done not even excepting the building of the great rapid transit system." Mayor Mitchel said that he believed that it would prevent in the future the enormous decline in property values such as had occurred below 34th Street in Manhattan. He believed that residence sections throughout the city would be protected against the sporadic store, factory or garage.

In general, the law will limit the height of buildings in proportion to the widths of the streets on which they face all the way from two and a half times the width of the street in the financial district, through two times the width of the street in central Manhattan, with one and one-half times in the balance of Manhattan and in small portions of the other boroughs, down to once the width of the street throughout all the rest of the city. A future Equitable building could only be a third as high, because it faces on narrow streets, but a tower in the center of it, half as large again as the Woolworth tower, might rise to any height. The Woolworth building on the other hand, if facing on a park, might be very nearly duplicated. The shopping district on Fifth Avenue will consist of buildings not much higher than Tiffany's but along 42nd Street buildings may rise about as high as the Hotel Manhattan or Knickerbocker. Twelve and fourteen-story apartments will continue to go up on the main avenues and eight and nine-story apartments on the side streets, but no building of any kind can go any higher except by setting back from the street. Throughout most of the city, however, four or five stories will be the limit. Towers may be built to any height but they cannot cover more than a quarter of the lot. Mansards, dormers and terraces are encouraged; anything that will open up the streets and bring light down into them by making the upper part of the buildings set back from the street above a reasonable height.

The size of buildings will be controlled by the fact that the law requires just so much open space on each lot. This again ranges all the way from the warehouse districts along the commercial waterfront and along the freight railways where a building may cover the whole of its lot, through the B, C and D districts so-called, in each of which in succession a building has to provide for larger and larger yards and courts, down to the villa districts where a house can cover only 30 per cent of its lot and must be widely separated from its neighbor on at least one side. Throughout Manhattan and the densely built-up portions of the other boroughs, yards and courts in office buildings, factories, lofts, hotels, apartments, in fact all buildings, would have to be as large as those that have been required for the last 14 years in tenement and apartment houses. Everywhere the yards and courts have to be increasingly larger at the top as a building goes up in height, so much so that these requirements tend to limit the practicable economic height of buildings even more effectively than do those directly affecting height. This is particularly true in the outlying boroughs. One important feature of the law is the encouragement it gives to playgrounds, for material concessions are allowed to anyone who will provide adequate recreational space in connection with his buildings.

Right here it is desirable to sound a note of warning. It would be most unfortunate if the law were applied as it stands to other cities, for it is full of unduly liberal provisions in the way of height and size that tend strongly to defeat the object of the law but which were necessitated by the exceptional economic conditions of New York.

As to the use of buildings there are only two general classes of restrictions; first, the districts which are restricted against business and industry of all sorts, the so-called "residence" districts, and second, the tracts which are restricted only against manufacturing and public stables and garages, the so-called "business" districts. In the former almost any kind of building that people live in is allowed, also churches, schools, hospitals and various institutional buildings. In the business districts any residence use is allowed and even a certain small proportion of the unobjectionable types of manufacturing. The use districts have been laid down street by street, and in fact block by block, depending on existing conditions and tendencies. The result has been that about two-fifths of Manhattan and about two-thirds of the whole city have been set aside for all time for strictly residential use, while the main thoroughfares, the transit streets and all other streets that are or might be appropriately used for stores or show rooms are set aside as business streets. Many streets which are now seriously invaded by factories or garages are restricted against them from now on, because it was felt that they were a distinct harm to the street. On this ground all of the central part of Manhattan above 23rd Street was made a business district despite the fact that there were already hundreds of factories, employing in all upwards of 30,000 operatives, within the district. This law will not touch the existing factory lofts as it is in no sense retro-active, but the "Saving

New York" movement, in which most of the merchants along Fifth Avenue combined to oust the factories in the neighborhood, has already succeeded in persuading almost all of the manufacturers to move away. It was a remarkable and timely vindication of the economic need of this law.

It is interesting to see how the unbroken residence districts have been becoming larger and larger at the insistence of the property owners themselves, so that in some cases of their own volition they must walk at least a mile to the nearest store of any sort. These restrictions do not interfere in any way with existing or future private restrictions placed on any property, except that if this law happens to be more drastic than the latter in any particular this law would govern.

All of the balance of the city which is not in one or the other of these two kinds of districts is left unrestricted. It includes all of the land appropriate for industry along the navigable waterfront and along the freight railways, as well as most of the territory which is now given over to manufacturing. It includes also, scattered throughout the city, a number of blocks which are already invaded by public garages or which are appropriate for that use. Certain other areas, especially around Jamaica Bay and along the shores of Staten Island are left entirely undetermined in their use pending the working out of the plans for the port and terminal facilities of New York.

The law will be adminstered by the city superintendents of buildings in each of the five boroughs and in so far as it affects tenement houses the law will be administered by the tenement house commissioner, while the following up of buildings after they are completed will be under the jurisdiction of the fire commissioner. In any case, wherever there is any question about the application of the law in a specific case, the matter can be taken to the newly constituted Board of Appeals, which is the board of review for all matters that relate to the construction or use of buildings. In addition, the law has in it a number of specific clauses giving the Board of Appeals discretion in allowing exceptions to the law.

The law itself can be changed only by the Board of Estimate and Apportionment which created it, and they can, after due notice and hearing, make amendments at any time, but if in any case 20 per cent of the property owners affected by a change object, the Board of Estimate can make the change only by a unanimous vote. There is also a clause which says that if on any street or district 50 per cent of the property owners sign a petition for a change in the map as affecting that district, then the Board of Estimate must act on it in one way or another within 90 days. It is realized that the law and maps are not perfect and they must be changed from time to time. The provision for change is made difficult as the whole law would be of no value at all unless property owners knew what to count on, and conditions were stable.

The idea of limiting the heights of buildings has often been broached in New York but it did not come to a head until early in 1913, when Mr. George McAneny, then President of the Borough of Manhattan, asked

the Board of Estimate and Apportionment to appoint a commission to consider the problem of controlling the height, size and arrangement of buildings. Such a commission of nineteen leading citizens, with Mr. Edward M. Bassett as Chairman and George B. Ford as Secretary, was appointed in March of that year, and after nine months of study presented a report in which they showed conclusively that the problem was far bigger than one of merely, limiting the maximum height of buildings, as that would affect only a small section of lower Manhattan. To that end they recommended two charter amendments which would permit the Board of Estimate and Apportionment to restrict the use of buildings, their height and the sizes of their yards and courts differently in different parts of the City. These Charter amendments were passed in May, 1914, and a month later the Board of Estimate and Apportionment appointed a Commission on Building Districts and Restrictions of seventeen members, with Edward M. Bassett as Chairman and Robert H. Whitten as Secretary, to carry the work through to consummation.

This Commission found that the first thing that it was necessary to do was to become thoroughly conversant with existing conditions and tendencies with regard to all property and improvements, the character and intensity of their use, all natural physical conditions as they affected property, and the distribution of the use and effect of public utilities. An intensive study of present and future rapid transit and the distribution of population in New York was made for the Commission by John P. Fox and Herbert S. Swan. Frank B. Williams made two trips to Europe to study the effect of the districting and zoning laws there.

A detailed study was made of what other American cities have done toward controlling the height, size or use of their buildings, but as no city had begun to approach the subject in a comprehensive way, the Commission found it necessary to go back to fundamentals. The first year was spent in collecting this data and getting it into form for use. Meanwhile the Commission and its staff were trying out every possible suggestion for controlling the size or use of buildings and the practicableness of various possible kinds of districts. It was a long process of elimination in which everything that would not work was discarded. The Commission held innumerable conferences and in all some 60 public hearings. They made a point of getting in touch with everyone who, through his experience or knowledge, they felt could assist in arriving at a practicable result. They went out continually to meetings of local groups in the various parts of the five boroughs as well as inviting people who were conversant with local conditions constantly at the office. The result is that the law as passed is not the work of a limited group of men but is the result of the combined thought of thousands of people from all parts of the city. The work of the two commissions is being summed up in a final report which will be completed within a few months. Meanwhile the law with accompanying maps as enacted, has already been published.

Despite the preponderating sentiment in favor of the plans as finally adopted and the almost unanimous feeling that districting was desirable,

it was realized that the law or some parts of the maps might be taken into the courts. As the law will be administered under the police power of the state, without compensation to property owners when they may feel that they are damaged, the Commission felt that it was highly important that the law and the district lines should be such as the courts would be likely to uphold as a proper exercise of the police power. Constantly the Commission wanted to be more drastic than they were, but they restrained themselves as they felt that it was far more important to plan a law which would be likely to be upheld by the courts rather than to secure all they felt desirable with the possibility of the whole law being declared unconstitutional. Recent decisions in the supreme courts of various states of the United States, and particularly in the supreme court of the United States, have given a remarkable impetus to the controlling of the development of private property along the lines which this law lays down.

The Commission constantly asked itself — "Will this particular feature of the law or will this particular district line tend to improve health, safety and general welfare?" — and as one goes through the various parts of New York and examines in detail what the Commission has done, he can study out the helpful effect it is bound to have; he can see what it is going to mean in relieving the inconvenience, danger and unhealthfulness in the rapid transit systems of the city, particularly in the central portion of Manhattan. It can be seen how it will tend to relieve undue congestion among the tall buildings of the city; how it is bound to improve business districts by keeping the factories out; how it is going to have a wonderful effect on family life, health, general welfare; how it will preserve the residential parts of the city and protect them against the invasion of business, factories and garages, and how it will show how everywhere at least a reasonable degree of light and air will be available for every building.

Another thing which the Commission kept continually in mind was the necessity of conserving real estate values. There were a number of leading real estate men on the Commission and they insisted constantly that real estate values must not be jeopardized and, wherever possible, that they should be enhanced. They soon found that that which was to the interest of the community from the standpoint of public health, safety and general welfare was also an advantage from a real estate standpoint, so the two points of view — human and business — have gone on together side by side, working to a common end.

The whole problem is related very closely to the rapid transit problem, in fact, to all the other features of the city plan. It has been borne in continually upon the Commission that districting without comprehensive city planning left the job only half done, and that as various new streets or parks were laid out, or new transit lines opened up, or terminal features planned, they would change the districts in their neighborhoods. It was a matter of great regret that it was not feasible in this case to carry on both the general planning and districting at the same time.

In the various reports of the Commission nothing whatever has been

said about the effect of the new law on the appearance of the city, and yet within the next twenty-five or fifty years it is bound to make the city far more orderly and even more beautiful. It has been said that it would spoil the glorious sky line of New York and rob the city of its "crowning glories." But so far from doing that, I am convinced that the sky line of New York some twenty-five or fifty years from now will be far more wonderful than anything we have yet dreamed of, for the law is full of special provisions which are bound to encourage the erection of towers, mansards, dormers, terracing roofs of a variety and interest far different from anything which this country has yet seen. More immediately, it will put order and harmony into the streets of the city, particularly the residential streets. It will tend to prevent the streets from being broken up as they are now.

Ultimately one of the greatest effects of all will be the effect which it is bound to have on family life and citizenship, for as the character of neighborhoods becomes assured families will begin to settle down in one place instead of constantly shifting about as they do now. Local ties will be formed, neighborhood spirit will grow: social and community consciousness will develop and people as groups will take more and more interest in the affairs, both social and civic, of their neighborhood.

The result is bound to be, as it always has been under similar conditions, that just in proportion as people do take more interest in their surroundings they contribute more to the direction of the control of these surroundings. In that way a civic spirit and citizenship is built up and in that way this new law is bound to contribute to better family life and better government.

Oil Storage.

By Garrett B. James (Member N. F. P. A.)
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Introduction

Although the petroleum industry of America is of comparatively recent origin, the crude oil has without doubt been long used by the Indians. In Sagard's Histoire du Canada, published in 1632, is a letter, dated 1629, which describes a visit of a Franciscan to the oil-springs of what is now the State of New York. Even though the existence of petroleum over quite a large area in the United States was known at an early date, there are no records of the systematic collection of oil prior to its being obtained in fairly large quantities from the brine-wells which were worked for salt extraction.

According to authentic records the first oil well, drilled by steam power, in the United States, was located near Titusville, Pa., in August, 1859, by Mr. E. L. Drake. Thus the year 1859 marks the beginning of the commercial development of oil resources in this country. The first

flowing well was completed about two years later. The following statement serves to indicate the early growth of the American petroleum industry: "In 1859 the total production, which was wholly obtained from Oil Creek, was 2,000 barrels. In June, 1860, the wells along Oil Creek yielded about 200 barrels daily, and in September about 700. The yield then rapidly increased, owing to the discovery of flowing wells, until during the winter and spring of 1861 to 1862 it amounted to about 15,000 barrels daily. The price obtained for the crude oil then fell so low that production was largely arrested, until 'the production in 1863 was scarcely half that of the beginning of 1862, and that of 1864 still less. In May, 1865, the production had declined to less than 4,000 barrels a day, the valley of Oil Creek being the only producing locality at that time.'" (Cone and Johns, Petrolia, N. Y., 1870.)

After the middle of the year 1864 the industry began to expand, and the production has since steadily increased with the opening of new fields in different parts of the United States. A combination of the figures for marketed production and of the estimated quantity of oil placed in producers' storage gives more than 290,000,000 barrels as the total yield of the oil wells of the United States in 1914. (Mineral Resources of U. S., 1915.)

As all the petroleum is not marketed immediately after production, containers for storage are a necessity. Some form of either temporary or permanent storage tank must be provided wherever an oil field is opened up and also at receiving points for the refinery industries.

Nature and Characteristics of Material.

Crude petroleum varies greatly in character and physical properties. It varies in color from straw-yellow to brownish-black. Some samples are highly mobile while others are quite viscid. According to different authors the specific gravity ranges from 0.771 to 1.06. The origin of petroleum has been the subject of much discussion among chemists and geologists for a number of years. Two groups of theories have been set forth, namely, the inorganic and the organic. The inorganic theories consider petroleum to have been produced from inorganic substances, while the organic theories state that it has resulted from the decomposition of animal or vegetable matter, or both. The organic theories, while still subject to considerable speculation, are now generally accepted. The two general classes into which petroleum may be divided are those of the "paraffin-base" and the "asphaltic-base." The first class mentioned yields solid hydrocarbons of the paraffin series while the other class is rich in asphalt and contains practically no solid paraffins. No sharp line of distinction can be drawn, as some oils contain both asphalt and paraffin. Chemically speaking, crude petroleum may be considered to consist essentially of a complex mixture of hydrocarbons of different boiling points often accompanied by sulphur, nitrogen and oxygen in small amounts.

Flash point determinations conducted on samples of crude oil show results as low as — 18.5°C. (—1.3°F.) with the Abel-Pensky instrument.

Tests of the explosive range of petroleum vapors have been conducted by numerous investigators, the results indicating that mixtures of the vapor with air, containing 2.5 to 10 or 11 per cent of vapor by volume are explosive.

Present Methods of Oil Storage.

Three general types of storage tanks are in use in the oil fields, namely: Steel tank with wooden roof, steel tank with gas-tight steel roof, and earthen tank. Steel storage tanks are sometimes of 35,000 or 37,500 barrel, but usually of 55,000 barrel capacity. At the end of the year 1915, there had been erected in the State of Oklahoma 1,552 steel tanks of the 55,000 barrel size and 17 more were in process of construction (Oil and Gas Journal, Tulsa, Okla.). The number of 35,000 and 37,500 barrel tanks that had been completed in Oklahoma up to the end of 1915 was 913. From these figures it may be estimated that over $25,000,000 is invested in steel tanks in this one state alone. The cost of hauling and grading for these tanks amounted to over $8,000,000.

In the construction of the large steel tanks with wooden roofs the steel entering into the tank shell and bottom is generally of open hearth steel plate. The roof is supported on wood posts with plates at the top. A wood sheathing is then nailed over wood rafters and covered with galvanized sheet steel, closely nailed, or with roofing paper.

In the construction of the steel tanks with gas-tight steel roofs, wood posts are usually eliminated and the roof supports consist of channels and I beams on pipe posts in place of wood supports.

Usually the oil fields are so far from the railroads that it is impossible to build tanks fast enough to take care of production, and much oil has to be stored in earthen reservoirs which are not much more than holes in the ground, roofed sometimes with corrugated iron or loose wood construction.

The loss of natural resources occasioned by storing oil in earthen storage has been brought out very forcibly many times and it may be easily perceived that the lighter constituents of the oil will soon pass from it into the air when no roof is provided for the tank. The roofs on any covered earthen tanks are generally of loose construction and evaporation takes place, but not quite as readily as in the case of open storage. In addition to the evaporation loss a considerable amount of oil is lost due to seepage. Oil standing in open earthen reservoirs has been known to shrink as much as 40 per cent in the course of 15 to 20 days.

The two main points to be considered in the storage of petroleum are evaporation and fire hazard. The loss of the lighter or more volatile constituents of the oil lowers its value to a more or less marked extent from the refiner's point of view. The open storage oil is reduced in value probably 30 to 40 per cent, but the fire hazard is somewhat lower, this immunity being secured due to the loss of the more volatile content.

Detail figures showing the loss by evaporation or seepage from a 55,000 barrel wood roof steel tank in Oklahoma during the summer and fall of 1914 are given below. The bottom and shell of the tank seemed

to be in good condition and the wood roof, covered with paper and tarred, was apparently tight. Between June 26 and September 4 the loss was equivalent to 993 barrels. The tank was then topped out and the loss between September 7 and November 23 amounted to slightly over 1,100 barrels, making the total loss about 2,100 barrels between June 26 and November 23. Other similar tanks showed a loss of between 2,000 and 2,500 barrels during the same period.

No detail figures concerning the loss of oil during storage in steel tanks with gas-tight steel roofs were available for comparison against the figures given above, but with tight roofs the evaporation has been found to be very much less. The estimated cost of putting on riveted and caulked steel roofs on steel rafters with posts, plates, etc., of steel is about $5,000 to $6,000 while the estimated cost of the wooden roofs generally used is between $3,000 and $3,500. A very conservative estimate of three per cent saving yearly, due to decreased evaporation losses with gas-tight roofs, should be considered. Figuring that the average amount in a 55,000 barrel tank is 50,000 barrels, the yearly saving would be 1,500 barrels of gasoline. As this gasoline is worth at least $4.00 per barrel, the yearly saving due to the gas-tight roof would be about $6,000. On this basis the difference of $3,000 in cost between the steel roof and the wood roof would usually be saved in a little over six months and in most cases in less than one year. A new wooden roof could be replaced by a steel gas-tight roof and the whole expense could be met by the saving due to decrease in evaporation losses in two or three years.

Submerged concrete tanks have been advocated in some parts of the United States and a number of such containers have been built. The construction cost has been high, and so far their use for the storage of oil has not always been satisfactory, as it is difficult to build a large reservoir through which the oil does not seep to some extent. It is often necessary to run water into concrete reservoirs to save the oil, the seepage sometimes amounting to hundreds of barrels per day.

Fires.

A complete record of oil fires in Oklahoma and Texas since the start of production is unobtainable. An examination of all available records covering the period from January, 1907, to January, 1916, shows that about 99 per cent of all fires were due to lightning. Of the total losses 32 per cent occurred during the month of August, and no losses were recorded for December or January.

Fires of oil in storage may be attributed to many different causes falling within two general classes, viz.: ignition by electrical discharge and ignition by communicated flames. Matches, smoking, open lights and friction have also been responsible for oil tank fires. Defective electrical installations and unprotected electric light bulbs may also cause oil fires and have been known to have done so. The boiling over of burning oil has often communicated flames from one tank to its surroundings, causing additional losses. Lightning has caused fires by striking drilling

derricks, gas wells, oil wells from which considerable quantities of gas were allowed to escape, flow tanks, stock tanks, gathering lines and pipe lines, the flames being communicated to near-by tanks.

In an oil field, lightning does not always strike single objects. For example, a fire in the Cushing field of Oklahoma might be cited. On August 27, 1914, a single flash of lightning caused a dazzling sheet of flame more than three-quarters of a mile in length and simultaneously ignited three 55,000 barrel steel tanks and many smaller tanks covering a range of one mile in length and one-fourth of a mile in width. The large extent of the fire may be considered as due to the fact that the lightning flashed into a highly inflammable atmosphere, over the field, composed of air and gas. Such an example serves well to indicate that storage tanks should be located away from the producing field. Open fires have been responsible for some quite extensive conflagrations and a number of smaller oil fires.

Numerous miscellaneous causes may be mentioned, among which are grass fires, brush fires, spontaneous heating of oily clothes and ignition of waste oil in the field or near storage tanks.

Present Methods of Fire Protection.

The precautions commonly taken for protection of storage tanks against loss by fire are as follows:

(1) Permanently grounding all flow lines or other pipe lines before making tank connections.

(2) Building a retaining wall or embankment around each.

(3) Having steam connections to all tanks and maintaining steam pressure in boilers so that live steam may be turned into tanks on the approach of a storm.

The practice of grounding all flow lines and other pipe lines before making connections to tanks is generally observed in the oil fields and on the tank farms. The usual method employed for pipe lines laid on top of the ground is to bury them for a short distance near each tank or well to which they are connected. Unless pipe lines are properly grounded, there is a danger of lightning causing the entire pipe line to become heavily charged. This might result in serious fires at all tanks and wells to which the line connects.

The embankments, built up of earth, around tanks are usually high enough to retain the contents of the tank in a quiet state, but when the oil is heated to such an extent that boiling occurs, and particularly if the earth is wet or water covered, the boiling of the oil causes it to overflow the embankment. In such a case additional embankments are usually thrown up to prevent the spread of the flames. Cannons are sometimes provided on tank farms, in order to be able to shoot a solid projectile through the wall of the tank. In this way the oil can be permitted to run out over the surface of the ground where it will burn harmlessly within its prescribed bounds.

Most of the steel storage tanks are provided with steam connections

at the goose necks, but some tanks have no provision made for the use of steam over the surface of the oil contents. The steam when properly applied, causes the liberated gas and oil vapors to be blanketed and rendered incombustible. The steam lines in many instances are laid on the surface of the ground, uncovered, and the heavy rains that usually accompany an electrical storm serve to cool the pipe and cause condensation. It is doubtful whether a sufficient volume of steam could be delivered through such a line to be effective at a tank any distance away. The apparent failure, in some cases, of steam to prevent the loss of tanks by fire cannot be considered as a proof that it is inadequate; the methods of application were probably at fault.

Suggested Precautions.

The precautions usually taken have undoubtedly, in many instances, prevented fires or served to reduce the amount of loss by fire. It is also true that there have been instances when the best methods of protection yet applied have failed in their purpose. Steam lines for all tanks should be of large size and enclosed in tight wooden boxes or otherwise insulated to prevent condensation. Suitable ground connection should be made at each tank. All pipe lines should be either underground or buried for a short distance near each tank or well to which they connect.

Drainage pipe connections of large size should be made to each tank, whereby a portion of the contents may be withdrawn by means of suction pumps and delivered to other tanks at a safe distance from the fire. Strainers of large capacity, and so arranged as to be readily cleaned without interrupting the flow of oil, should invariably be installed in such suction lines, as otherwise the pump would be rendered inoperative by the quantities of charcoal or other material that would find its way into the suction line with the oil.

The most effective means known of reducing the fire hazard of oil in steel storage would be the equipment of all steel tanks with *gas-tight steel roofs*, properly vented, so as to eliminate any possibility of backfiring. All steel tanks and pipe lines connected to them should be thoroughly grounded electrically. The wooden roofs at present in use on steel tanks may be greatly improved by the addition of a substantial metallic sheathing, making good gas-tight electrical connection with the shell of the tank, thoroughly grounding the tank electrically, and making the roof gas-tight. The electrical connection between the metallic covering over the wood and the shell of the tank may be made by bringing the sheathing over and under the angle iron at the top of the shell. This joint should be made gas-tight by means of caulking or a suitable material used as a gasket. The top angle should be tightly caulked to the shell, using additional rivets where necessary.

As a thoroughly grounded gas-tight tank of metal, or one sheathed with metal, is safe from damage by lightning, and will also reduce evaporation losses to a very marked extent, the additional cost for building such a tank will be saved in a comparatively short time.

The use of explosion hatches is strongly advocated by some tank builders and tank owners; but with a gas-tight steel roof and proper vents, in a territory where fires and explosions from causes other than lightning are not feared, no explosion hatches would be needed. As an additional safeguard they might be used. If used at all, the explosion hatches should be of very light construction. Tanks equipped with gas-tight roofs should be provided with suitable vents to take care of the rise and fall of the level in the tank due to inflow or discharge of oil. These vents must also prevent the ignition of the gas in the tank through the vent. The gauge hatches in the roof should be made tight or have hinged covers which by their own weight would maintain a gas-tight joint. These hatches should be closed, except when gauges are being taken. The location of these hatches is a matter of choice, but the placing of one near the stairs would be very convenient for ordinary gauging. The winch-box, or boxes, should be gas-tight to carry out the plan of making the roof gas-tight. As the value of the gas-tight roof depends upon its condition, careful inspection should be made frequently of the roofs, vents, gauge hatches and explosion boxes, if any are used.

Another idea in connection with the use of gas-tight steel roofs has been suggested. The tank is to be so constructed that a small pressure will be maintained in the tank at all times. When this pressure increases, due to expansion of the vapor above the oil, it will be relieved automatically and kept at the correct amount. If contraction of the vapor occurs, natural gas will be introduced over the surface of the oil to maintain the proper pressure. With such an arrangement, the evaporation will be reduced to a minimum and the mixture over the oil will be kept too rich in vapor to explode. A pressure regulating device could be placed on the tank and no difficulty would be encountered in maintaining the desired pressure in the tank. Another economical system would contemplate the use of gas-tight tanks for oil, with a suction pipe connection to the space above the oil, whereby the gas which arises from the oil may be withdrawn from the tank. This gas could then be delivered to a compressing tank for extraction of gasoline, utilized commercially as a fuel, or carried to a safe distance from the tank before liberation.

The question as to whether an empty tank should be set aside on each tank farm, to be used in case of fire, is subject to much discussion. The expense of erecting a spare tank seems to be the main objection offered to this course. It would be advisable, if possible, to keep some space available on each tank farm. The practice of storing oil in the producing field should be discouraged, as it has the disadvantage of concentrating the fire hazard and it would seem that, as far as possible, storage tanks should be erected in a district remote from the producing field and beyond the possible fire zone of the field.

The placing of additional cross walls on a tank farm would be of marked advantage, in case of a burning tank boiling over. Protection would thus be afforded to adjoining property. This distance between tanks on a farm should also be considered. Cases have been recorded

in which burning oil has been thrown approximately 500 feet from one tank to another, causing further damage. It is suggested that tanks be placed as far apart as possible, to avoid danger from this source.

The use of a tenacious foam solution as a means of extinguishing oil fires has been brought to the attention of the oil producers in this country during the last two years. The process consists essentially in mixing two chemical solutions, to produce a thick tenacious foam, containing bubbles of carbon dioxide, and in spreading this foam over the surface of the burning oil. There are two methods of application of the foam: 1st, pumping the two chemical solutions from a central point through twin pipes to a point as near as possible to the oil tank, bringing them together in a mixing chamber and allowing the foam to spread over the burning oil; 2nd, automatic distribution from foam generators on each tank. The distribution of foam from generators on each individual tank has the distinct advantage that the generators are installed so that they will operate automatically. The foam is produced by the action of sulphuric acid on a solution of bicarbonate of soda and soap bark in water. The following descriptive matter is quoted from a statement of the manufacturer of the automatic foam extinguisher: "It is the intention to install the apparatus in two different types, one called the stand-pipe method, and the other the underground method. The reason for this is as follows: On any container in which there are steam coils, the stand-pipe method is used, and a small coil put on to prevent the solution freezing. Also the solution can be protected from freezing in the stand-pipe method by means of electric heaters. However, there are locations where neither steam nor electricity are available, and in these the underground method is used. In this case the solution tank is put underground to prevent it from freezing; the acid, of course, will not freeze."

In the installation of the above-ground type the stand-pipe is mounted, alongside of the oil tank, on a concrete base, and contains a solution of sodium bicarbonate and soap bark in water. Above the level of the soda solution is mounted an acid container in which sulphuric acid is stored. Below the acid reservoir and extending down into the soda solution is a perforated pipe through which the acid when released, goes into the soda and soap bark solution and generates foam which passes through the outlet at the top of the stand-pipe and into the tank. The release of the acid is accomplished by one or more fusible links melting and allowing the hammer at the top of the acid tank to fall on a plunger and break the glass plate in the acid box at the top of the acid discharge pipe. The fusible links are so arranged in the tank that there is always one near the surface of the oil. Other links are located in chains placed horizontally across the tank just under the roof and running over sheaves down into the tank.

In the underground method of installation the tank containing the solution of sodium bicarbonate and soap bark is placed below the ground level and the top of the sulphuric acid container is just above ground.

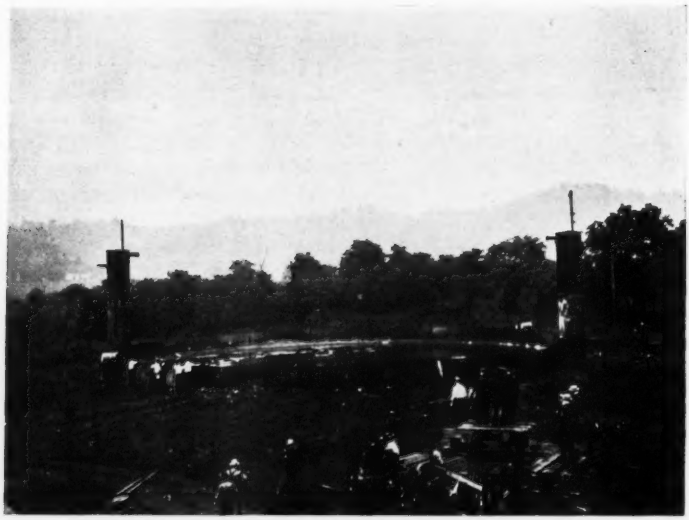


Figure 1.

The foam is conducted from the generator to the top of the oil tank by means of a vertical discharge tube. This type of generator is equipped with fusible links arranged in a manner similar to those used in connection with the stand-pipe type of generator. The fusible links used are designed to fuse at about 212° F.

Tests of this extinguisher were conducted by the Underwriters' Laboratories at the shops of the Treadwell Construction Co. (builders of the device), at Midland, Pa. As shown in Figure 1, the first ring, about 5 feet in height, of a 55,000 barrel steel tank was set up on a concrete base. One stand-pipe type of generator was erected as if the tank had been built up to its full height. From a post, in the bottom of the tank, about 40 feet from the base of the generator a chain was run through the discharge tube and connected to the hammer above the acid reservoir. In this chain were placed a number of fusible links, one being about 2 feet, in a vertical line, above the surface of the oil in the tank. Onto a two-foot layer of water in the tank about 100 barrels of crude oil were run and on top of this were poured 100 gallons of gasoline. The flammable liquids were ignited near the center of the tank by means of lighted cotton waste thrown over the side. In a short time the entire surface of the oil was in flames. Approximately two minutes after the fire was started, the hammer above the acid reservoir was automatically released by means of the fusing of a link. Twenty seconds elapsed after the release of the hammer before any foam came from the discharge tube of the generator. Then foam fell onto the surface of the oil and gradually covered the whole area and extinguished the fire. The time required, after the foam started from

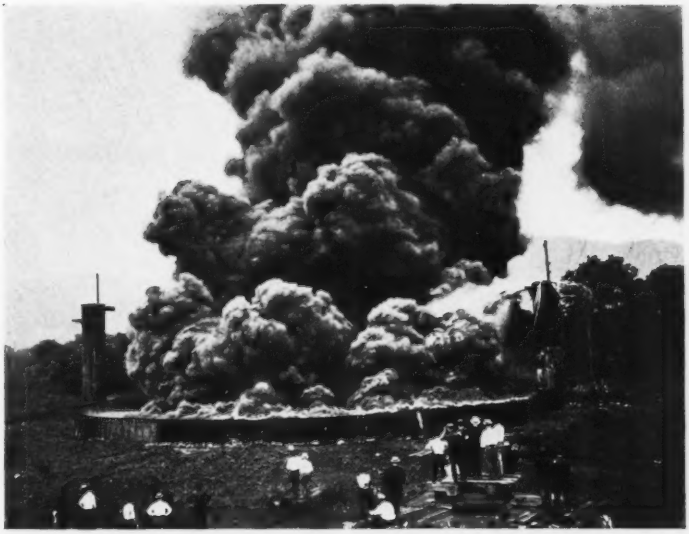


Figure 2.

Taken shortly after the foam started from the generator.

Figure 3.

Shows about one half of surface of oil covered with foam.

Figure 4.

The foam has completely covered the surface of the oil and extinguished the fire.

the discharge tube, to extinguish the fire was one minute and thirty-five seconds. Thus the total time from the start of the fire until it was extinguished was approximately three minutes and fifty-five seconds. During the test a wind with a velocity of about 12 to 15 miles per hour was blowing at right angles to an imaginary line between the center of the tank and the generator. The vertical distance from the level of the oil in the tank to the lowest part of the discharge tube was about 28 feet. Numerous other very successful demonstrations of this device have been made at different points in the United States.

Lightning rods have been applied to storage tanks without marked benefit; in fact, it has at times seemed that tanks carrying lightning rods were the most likely to be destroyed.

In several articles written by Mr. E. A. Barrier it is maintained that sawdust with about ten pounds of sodium bicarbonate per bushel of sawdust is superior to sand sometimes used for extinguishing fires in tanks of inflammable liquids. Carbon tetrachloride is very useful as an extinguishing liquid, but its anesthetic properties and cost tend to prohibit its use in the petroleum industry. It is believed that the most efficient extinguisher for oil tank fires is the foam extinguisher.

Southwest Oil Field Fires.

Journal of Commerce, N. Y.

DILWORTH, OKLA., Dec. 29.— The losses from fire in the oil fields of the Southwest during the year 1916 will aggregate, it is estimated, more than $4,000,000. In a majority of cases the fire was caused by lightning. The electric storm season in Oklahoma is always one of constant danger to the oil industry and annually the toll is very heavy. It was estimated that these losses had aggregated more than $2,000,000 by July 1, 1916, and that during the spring months alone a total of 280,000 barrels of oil in storage had been destroyed by lightning.

There were 138 storage tanks of all sizes destroyed by fire in this State alone during the last year. Of these, twenty-seven were of the 55,000-barrel capacity, twenty-three of the 1,600-barrel size, twenty of the 250-barrel size, seven of the 500-barrel size, one of the 1,800 size, one of the 3,000 size, one 100 barrel tank and fifty-eight flow tanks.

As nearly as can be estimated from the above figures, there were 1,535,200 barrels of oil in storage destroyed by fire during the year, and at an average price of crude oil for the year of $1 per barrel the total loss in oil alone amounted to $1,535,200.

The loss of natural gas by fire during the year also reached a large figure.

There were numerous big fires and in some instances the wells burned for several weeks before the fire was conquered. The Gypsy Oil Company had a 40,000,000 cubic foot daily producer, southeast of Shamrock, that burned for thirty days and that, no doubt, was the heaviest single gas loss during the year.

The amount of gas consumed in the burning of wells easily reached a total of 1,660,000,000 cubic feet, estimating a total of 166,000,000 cubic feet destroyed daily for a period of ten days. If converted into gasoline that amount of gas would make 4,980,000 gallons, on the Government basis of 3.1 gallons for each 1,000 cubic feet of natural gas in Oklahoma, and at 15c. a gallon the value of the gasoline would be $747,000.

The most destructive oil field fire of the last year was that which swept over the central portion of the original Cushing field, five miles north of Shamrock, the last week in March, resulting in $1,000,000 loss. A forest fire started and spread rapidly, burning nearly two days. The loss included at least one hundred derricks, many flow tanks, stock tanks, one 55,000 steel tank, several pumping stations with their equipment of engines and boilers, a number of warehouses and tool houses and many small houses, tent-houses and tents, the homes of oil field workmen.

The continued loss from lightning is leading several oil companies to experiment recently with concrete tanks, and in all probability such tanks will take the place in great part of those built of steel. The oil men figure that the concrete tank will reduce rates on oil storage insurance. Metallic tanks have the reputation of being too attractive to lightning. In numerous instances the oil companies carry their own risks on their tank farms and other property in the oil fields.

Underwriters' Laboratories

Work in 1916

The steadily increasing demands upon the facilities of Underwriters' Laboratories for service during the year, in the endeavor to lessen the fire loss and reduce the accident hazard, evidence the growing appreciation of this organization's work. The following brief outline indicates the trend of the work carried on by the Laboratories during 1916 and mention is here made of some of the more important developments.

Several standards covering the construction and performance in tests of devices have been issued during the year.

In meeting the multiplying requests for service the Laboratories in co-operation with the industry have evolved a new plan whereby the name of the Laboratories and the word "Inspected" or some suitable abbreviation, is to be directly applied on the article as a part of the manufacturing process.

The services provided are: (a) Inspections at factories with examination and tests of samples of newly assembled material and material in stock, (b) Counter-check tests of samples of labeled goods obtained in the market, (c) Field follow-up tests of samples secured through the co-operation of inspection authorities and users, providing for service value determinations of labeled products, (d) Summaries and schedules of results of tests made, and comparative demerits awarded individual manufacturers employing the Label Service and industries as a whole.

The Laboratories' service of inspections at factories, whereby goods found to be standard bear an inspection manifest or label, has been held back from many lines because of the expense of applying a label of the usual type. Package labeling, while in effect for a number of appliances, has not, by practical trial, been proved to be the correct solution. Advantages secured through the new labeling plan are — the savings effected in cost of labels, and the permanancy of the inspection symbol. Under this plan no claim can be made that sub-standard appliances were actually labeled at any time and that the label has been lost.

Inspection service at factories and labeling under both the old and new plans are now in operation in some twelve hundred manufacturing plants.

The work of the electrical department is conducted partly at the principal office and testing station in Chicago and partly at the testing station maintained in connection with the New York office. The New York Station is provided with all the test equipment, instruments and

apparatus for electrical tests as employed at Chicago and the work is now about equally divided between the two stations. Mention should be made of check tests at two factories by the New York Station on very large orders of fire alarm cable to be used in rehabilitating the New York fire alarm system. These tests are being made at the request of the New York Board of Fire Underwriters and supplement the city test.

During the year the Laboratories have co-operated actively with the manufacturers of electrical fittings and supplies by the establishment of industry conferences, composed of appointed representatives of the manufacturers and the engineers of the electrical department of the Laboratories and these conferences have, in turn, reported to the various sections of the Associated Manufacturers of Electrical Supplies, for the purpose of formulating and recognizing standards of design and construction affecting electrical materials and appliances. Such standards as well as several covering other devices, not electrical, have been issued during the year.

The column testing apparatus, begun in 1915, is nearing completion and in all probability will be in readiness for preliminary tests early in 1917. Built-up steel columns used in modern buildings can with this apparatus be tested under actual conflagration conditions and under a maximum load, if need be of 500,000 pounds.

Progress has been made in standardization of tests designed to furnish information on fire doors as to strength, durability and accuracy of workmanship. Advances for the year in door manufacture seem to have been confined to improvements in design and manufacture of types already found efficient when exposed to high temperatures. With rolling fire doors, the tendency has been towards the improvement of operating mechanisms with the idea of facilitating manual operation and refining the details involved in automatic operation. Door locking and closing mechanisms have received considerable attention and wire rope and various types of chains for such devices have been investigated.

During the year the standard for roof coverings has been revised, reducing the number of classes into which roofings were divided, from six to three. Since 1915, tests and reports have been made upon a large number of roof coverings of various kinds, including coverings which complied with the requirements of the three classes. In this connection a standard for asphalt rag felt prepared roofings and shingles has been prepared in conjunction with a committee representing the manufacturers in the industry, and the Laboratories are now inspecting and labeling the product of some 30 odd manufacturers of this class of material. Roofing apparatus and equipment have been standardized and tests can be made on all kinds and classes of roofing.

Gypsum blocks for use in room and corridor partitions have been investigated with a view to extending the classification of this material to cover its use for other purposes. Hollow tile walls are receiving attention to determine if they are suitable for use as bearing walls and fire walls.

In gas and oil appliances the three principal classes of materials which have received attention have been first aid fire extinguishers, containers for hazardous liquids and acetylene apparatus for welding and lighting. New types of extinguishers are being examined and listed. New types of discharge devices, particularly such as make the measurement of liquid visible to the consumer are frequently being presented and the problem of rapidly handling hazardous liquids with safety is not being neglected. Excellent co-operation from manufacturers has resulted in progress in standardization of rules governing the building of welding apparatus.

The new hydraulic laboratory has proven its worth in facilitating the work upon hydraulic devices undergoing test, and additional test apparatus is being added from time to time as needed.

Some 1300 sprinklers have been removed from 200 different equipments in the field and examined to determine the reliability of the remaining sprinklers in these plants. This work is increasing and is becoming more important owing to the larger number of aging installations each year. Work has been started on tabulations of the test results of these field samples to ascertain the safe average life of automatic sprinklers in various occupancies, information regarding sprinklers from tanneries, bleacheries and dye-houses being of special interest. It is intended to gradually broaden this work until accurate data is at hand defining the period of reliability of sprinklers. Test work on experimental samples of sprinklers and other devices used in sprinkler equipments has greatly increased.

The casualty department has had submitted for review 24 different devices, nearly half of which were automobile locks. Other kinds of materials or appliances presented were: anti-slip treads; elevator safety devices; portable fire escapes; printing press guards; stair guards; window cleaners' belts; materials for the construction of guards; guards for machinery; safety flanges for grinding wheels; ladder feet and step ladders. One product of special interest is a new glass product which is essentially a celluloid glass sandwich, being constructed of a sheet of celluloid between pieces of glass and designed to reduce accidents due to flying particles of broken glass in automobile, street car and railroad accidents. The group of automobile locking devices intended to secure automobiles against theft offer a variety of methods, among which may be mentioned locking of the gasolene supply, both in the supply line and the intake manifold; locking of the ignition circuit, in some cases separately and in others in conjunction with gasolene locking devices; locking of the steering wheel disengaged from the steering post; short circuiting the high tension wiring and other methods.

Materials for the construction of machinery guards have come before the Laboratories in the form of both expanded and perforated metals, tests being made to bring out their values in the construction of guards. Of valued interest is the testing of safety flanges for guarding wheels, which tests are now under way, and in which endeavor is made to measure

the holding power of flanges such as are used with tapered wheels to determine the probability of the escape of segments of a wheel which might be accidentally broken during operation. These tests should be productive of valuable results and are of special interest to makers of grinding machinery.

The label service and other methods of supervision are being extended to the new industries as well as being continued and broadened in previously established lines. Standard test methods are being employed, test apparatus is being improved, and this department expects a busy year in 1917.

Besides work in the chemical department on fire hose and hose couplings, chemical extinguisher and gasolene hose, insulated wire and cable, rigid conduit, matches, stationary foam extinguishers, oil tank vents, hazardous liquids, and various proprietary articles, investigations in the field as to the hazard of plants manufacturing phenol, dyes and cotton seed products were conducted, and an investigation of the conditions having to do with the safe storage of oxygen under pressure was begun; research work on braids of insulated wire was carried on as a basis for forming a specification; specifications for rubber discs used on alarm and dry pipe valves were formulated; work in determining the characteristics of several bronzes and copper alloys was begun; and research work to obtain a suitable accelerated life test for rubber used in the manufacture of insulated wire is in progress.

Friends of Underwriters' Laboratories have felt that advantage should be taken of all proper means available for keeping insurance people, and the public as well, informed concerning the work of the institution. In line with this, the practice of providing moving pictures of parts of the work was undertaken a little over a year ago. These have been furnished to insurance organizations, state and municipal officials, credit men, churches, schools, chambers of commerce, city clubs, rotary clubs and various other classes of organizations and interests for projection at meetings and conventions in cities and towns in more than half of the states and in Canada. Whenever the usual routine of the Laboratories' activities has made it convenient to do so, a lecturer has been provided along with the pictures. This has been the case perhaps two-thirds of the times when the films have been shown. These pictures are being revised and greatly extended at this time, with the addition of comprehensive explanatory titles, and here and there, of scenes of a popular, human interest sort. They will continue to be available for projection where they can be effectively used.

There are about 130 persons on the staff of the Laboratories at Chicago now. Branch offices and branch testing stations employ between 350 and 400 persons.

Courtesy G. Chal Port, Fire Marshal. (Member N. F. P. A.)

Scranton, Pa., Fire Hazards due to caving in of coal mines. Before the cave-in this street was perfectly level. Owing to the breaking of the water pipes in the event of fire a disastrous conflagration might result.

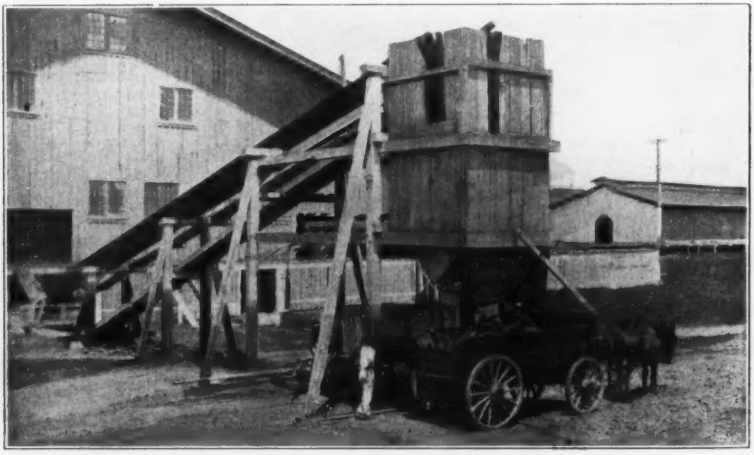
Courtesy G. Chal Port, Fire Marshal. (*Member N. F. P. A.*)

Dangerous fire hazards on North Main Avenue, Scranton, Pa., caused by the caving in of the coal mines beneath this particular portion of the City. In some instances the entire cellar disappeared.

Which Plant Is Best Safeguarded Against a Disastrous Fire?

Lumbermen's Underwriting Alliance.
(Member N. F. P. A.)

Would sparks, carried by an October gale to your mill, find a lodging place like this awaiting them, with the same opportunity for flames to sweep under and through the entire building?



Or is the refuse disposed of as it accumulates—like this—leaving only clean, bare, well painted and whitewashed surfaces?

Fire Departments and Automatic Sprinklers.

That the old time attitude of American fire chiefs toward the automatic sprinkler as a fire fighting agency is suffering radical modification, is demonstrated by the experience of a committee which made its first report this year at the convention of our organization member, the International Association of Fire Engineers.

The chairman of this committee, whose labors are by no means completed, is Chief Howard L. Stanton of Norwich, Conn, long and favorably known to members of the National Fire Protection Association as a working member of the Committee on Standard Hose Couplings.

The fire chiefs' committee of which Chief Stanton is the head was appointed at the Cincinnati Convention of 1915, following the delivery and discussion of a number of interesting papers on the general subject of the attitude of fire chiefs toward the use of the automatic sprinkler. The committee was appointed "to investigate ways and means whereby automatic sprinkler systems may be used to best advantage by fire departments as fire defence auxiliaries," this action being taken in compliance with one of the provisions of a resolution unanimously adopted endorsing the automatic sprinkler as "an important means of controlling conflagration conditions in cities and modifying responsibilities of fire departments, also as a most valuable auxiliary in fire department operations."

As preliminary to the handling of this big subject by his committee, Chief Stanton determined to ascertain from the fire chiefs of the cities what practices are followed by them in fighting fires in buildings equipped with automatic sprinklers. Six hundred fire chiefs subsequently received a question blank with the following interrogations:

Fire Department Connections

1. Are sprinkler systems provided with fire department connections — one-way or two-way (Siamese) couplings — for attachment of hose to supply water to systems?
2. Do you attach hose to fire department connections of sprinkler systems when responding to alarms of fire in sprinklered buildings?
3. If you do attach hose to fire department connections, will you please explain what method you follow, whether first or second crew responding couples up, etc., also what orders are in effect (please send a copy of them, if possible) and all other details about how you use fire department connections of sprinkler systems?
4. If you do not attach hose to fire department connections of sprinkler systems, will you please explain why you do not?

Procedure Followed at Fires in Sprinklered Risks

5. What practice do you follow in handling fires in sprinklered risks?

6. Do you require that water shall not be shut off from sprinkler heads until it has been definitely found out that the fire is under control?

7. Do your men shut off the water when fires are controlled?

8. Do you require that sprinkler systems be put in commission, fused heads replaced, water turned on, before all firemen return to quarters?

9. Do your men replace fused sprinklers with new heads and turn on water?

Sprinkler System Automatic Alarms

10. Are any sprinkler systems in your jurisdiction equipped with automatic alarm valves which have connection in some way with fire headquarters? If you can, please specify what are the kinds of connections.

11. What practices do you follow in responding to sprinkler system automatic alarms?

12. Is there a full or partial first-alarm response?

13. Are you troubled any with needless alarms from sprinkler system automatic alarms, alarms not caused by fires?

14. What do you think the reasons are for the needless alarms?

Knowledge of Sprinkler Systems

15. What officers of your department are familiar with the sprinkler systems in your jurisdiction, the location of control valves and the parts of the systems they control, etc., particularly the sprinkler systems in the buildings in the high-value districts?

16. How have your officers become familiar with the sprinkler systems — by inspecting them independently, or in company with insurance inspectors, or with engineers or foremen of sprinkler companies?

17. Do you maintain a practice of monthly or quarterly inspections of sprinkler systems, and, if so, who inspects?

18. Do you have one man or a crew of men who expressly look after sprinkler systems, either at all times or at fires?

19. Do you keep a record of the names of sprinklered risks?

20. Do you keep a record of the condition of sprinkler systems, whether they are in service or not, etc.?

21. Do you have in your files complete descriptions of sprinkler systems, either written reports or plans?

22. Do you keep a record of the fires controlled by sprinklers?

23. Do you require owners of sprinklered properties to send you reports of fires controlled by sprinklers?

24. How many sprinklered risks are there in your jurisdiction?

Other Things

25. What do you think about automatic sprinkler systems as a practical help to firemen?

26. Have you any suggestions in mind for things or changes in sprinkler systems that will make them conform better to fire department practices?

Open or Outside Sprinklers

All previous questions refer to automatic sprinkler systems inside buildings and now we would like to ask you a few questions about open sprinklers (not automatic) — so-called water curtain systems, which have open sprinklers covering walls of buildings, and in new standard equipments, at least one head over each window.

27. Have you any such systems in your jurisdiction? How many?

28. Are they supplied with water through a permanent connection with the public water main? If in some other way, please describe.

29. Are they fitted with fire department connections for attachment of hose so that fire department apparatus can supply water?

30. Would you use such fire department connections?
31. Are the officers of your department familiar with these systems, what exposures they aim to protect a building against, the location of valves controlling water supply, etc.?
32. Does your department inspect and test these open sprinkler systems at all? If so, please explain the system of inspection and tests.
33. What do you think about open-sprinkler water curtains as a help to firemen?

The time was insufficient for a thorough canvass but up to the date of the August 1916 fire chief's convention at Providence, more than 100 chiefs had returned the question blank, and 95 of these were quite complete. It was not possible for Chief Stanton to completely analyze the results before being called upon to present his report.

The 95 reports are from cities having a total of 10,303 sprinkler equipments. The following tabulation is a classification of the reports according to the number of sprinkler systems per city, which shows that more than half the responses are from cities having less than 50 sprinkler systems each.

Sprinkler Systems per City	No. of Cities	Total No. of Systems
500 and over	4	4,436
250 to 499	7	2,215
100 to 249	13	1,848
50 to 99	16	1,002
25 to 49	12	381
10 to 24	22	303
5 to 9	16	103
Less than 5	5	15

Responses to questions numbered 1 to 4, relating to fire department connections to sprinkler systems, and 5 to 9 relating to fire department procedure at fires in buildings equipped with sprinklers, were hurriedly analyzed, and presented to the meeting as follows:

Question 1. Are sprinkler systems provided with fire department connections — one-way or two-way (Siamese) couplings — for attachment of hose to supply water to systems?

Answers. Eighty-five per cent. of the responses to this question report that sprinkler systems are provided with fire department connections. About ten per cent. of these report only a few connections.

Question 2. Do you attach hose to fire department connections of sprinkler systems when responding to alarms of fire in sprinklered buildings?

Answers. Seventy per cent. report they do, and thirty per cent. they do not.

Of those who do, nearly one-half make a practice of connecting promptly, and the remainder connect at will. Most of the latter say they connect "if necessary," some "at the discretion of the commanding officer," and others under various conditions. One connects only with sprinkler system in high buildings; another, to systems that have no tank supply.

Chief Delfs (Lansing, Michigan) says: "Not always, but it should be done at all times in my opinion." Chief Rozetta (Nashville, Tenn.) says: "I do, if conditions seem to justify it. Uusally the fire is controlled by the sprinklers when the department arrives." Those who do not connect, tell why, in response to question 4.

Question 3. If you do attach hose to fire department connections, will you please explain what method you follow, whether first or second crew responding couples up, etc.; also what orders are in effect and all other details about how you use fire department connections of sprinkler systems?

Answers. Sixty per cent. of those who attach to connections, follow a method. Forty-three per cent. of these report that the first company responding couples up with steamer connections; fifty-two the second company, and the remainder the second-alarm companies. Among the larger cities that have a method of using steamer connections, are: Binghamton, Buffalo, Chicago, Detroit, Milwaukee, and St. Louis.

Of the reports that first companies connect, about one-third say that the first lines stretched are connected, one-third, the second lines and the other third do not specify which. Only two report actual orders in effect, Chicago and Milwaukee.

The Chicago Fire Department rule is as follows:

"Whenever a fire occurs in a sprinklered building, the commanding officer of the first engine company arriving shall immediately connect his second line into the sprinkler system and charge the same."

Milwaukee's rule is the same.

Chief Broderick of Detroit advocates attachment of first lines. He says: "The first company to arrive connects the first line to the sprinkler connection and starts pumping, if necessary. Then they stretch the second line and act as conditions require. If the fire seems to be gaining headway, we connect a line from another engine. When you connect a line to a sprinkler system, you can use the men for something else."

Three report that pumping is begun as soon as connections are made, and seven that pumping is not started until orders are given.

Among the larger cities that do not have a definite method of using steamer connections are Baltimore, Boston, Pittsburgh, Newark, and Rochester.

Chief Johnson of Bridgeport, Conn., who reports that connections would be made "where overhead tanks are not in use," says: "There are no rules at present but some such rules under consideration."

Question 4. If you do not attach hose to fire department connections of sprinkler systems, will you please explain why you do not?

Answers. Nine respond they do not, because they consider the public water pressure sufficient. Other reasons why connections are not made are classified as follows:

No connections, 6.
Very few connections, 2.
City water pressure sufficient, also tank supply, 4.
Sprinklers usually control fire, 3.
Never found it necessary, 3.
If more water necessary, use hose, 3.
Tank supply considered sufficient, 2.
Two water systems, high and low service, 1.
City water pressure sufficient, except in high buildings, 1.
Systems supplied by city water and private pumps, 1.
Except when water is shut off from street mains, 1.
If fire can be reached with chemical lines, 1.
Except when fire gets beyond sprinklers, 1.
Seldom need more water, 1.
Hose streams worth more, 1.
No pumping apparatus, 1.

Question 5. What practice do you follow in handling fires in sprinklered risks?

Answers. Only 50 per cent. of responses report that a practice is followed, but this number represents 75 per cent. of all the sprinklered buildings in the jurisdiction of the chiefs who have responded thus far to the questions. The smaller cities make an excellent showing in the responses to this question. The practices followed are, briefly, as follows:

Minneapolis, Minn.: "First company stretches line to fire — if controlled, sprinklers shut off."

Salt Lake City, Utah: "Locate fire; if sprinklers cannot control, have hose lines ready."

Lexington, Ky.: "Depend on sprinklers to control fire, but apparatus held ready to take hold, if necessary."

Rockford, Ill.: "Let sprinklers do it, if possible — if they cannot, help out with hose streams."

Wakefield, Mass.: "Make sure sprinklers are controlling or have controlled fire. Avoid, if possible, use of large streams inside buildings. Station man at valve to shut off."

Austin, Tex.: "Lay hose, but do not use unless required, or unless water from sprinklers is more than required to extinguish remaining fire."

Lynn, Mass.: "Station men to shut off when ordered. When fire is located and under control, water ordered shut off and floors swept."

Wheeling, W. Va.: "If fire not checked, department assists in extinguishing it. If under control, water shut off and drained, and goods overhauled."

Louisville, Ky.: "Experience has been that before arrival, fire was under control or out, and water was ordered to be shut off."

Seattle, Wash.: "Department always found fire under control."

Grand Rapids, Mich.: "Immediately determine amount of fire; stop flow of water as soon as practical. In the majority of cases, fire is extinguished by sprinklers, or can be handled by chemical streams."

Augusta, Ga.: "First-line crew locates fire, separates goods, and shuts off sprinklers, if fire covers small area — lines with shut-off nozzles stretched to be ready to prevent spread of fire. Water shut off as soon as possible; floors mopped, and water scooped up to prevent seeping through floors."

Albany, N. Y.: "Shut off sprinklers when fire controlled, and use water or chemicals, if necessary."

Albany, Ga.: "Station man to shut off promptly, if fire controlled or can be controlled by chemicals."

Hamilton, Ont.: "If fire is controlled, shut off and use water or chemicals; if not controlled and too many heads open to weaken pressure, use both hose and sprinklers until fire is controlled before shutting off sprinklers."

Detroit, Mich.: "If fire under control, shut off sprinklers and extinguish remainder as thought best."

Milwaukee, Wis.: "When fire controlled, shut off and drain sprinklers, and put out balance of fire with such equipment as may be necessary."

Cohoes, N. Y.: "As soon as fire is *located*, sprinklers shut off and water or chemicals used."

Bristol, Pa.: "Keep sprinklers on until our lines are laid."

Lebanon, N. H.: "Sprinklers shut off, if we cannot see any flames."

Newark, N. J.: "Stretch lines and go to work."

Holyoke, Mass.: "Same as at any fire. If delayed in shutting off sprinklers, use brooms to remove water."

Kokomo, Ind.: "We work in conjunction with sprinkler system."

The foregoing comments are not all that have been received; they summarize the practices followed.

Question 6. Do you require that water shall not be shut off from sprinkler heads until it has been definitely found out that the fire is under control?

Answers. Eighty per cent. do, fourteen per cent. do not, and six per cent. non-committal.

Chief Bywater, Salt Lake City, says: "Do not allow any shut off until an officer has made a thorough investigation and is satisfied that the fire is out."

Chief Boughner of Grand Rapids says: "We take no chances. It would certainly be a fatal mistake to do otherwise."

Question 7. Do your men shut off the water when fires are controlled?

Answers. Ninety per cent. of responses report that fire departments do this, and ten per cent. that they do not.

Of those that do, 4 direct salvage corps to do it, and 8 instruct building employees.

Chief Boughner says the reason his men shut off sprinklers is because "watchmen as a rule understand very little about sprinkler systems."

Chief Nissen of Winston-Salem, N. C., says his men shut off "if it is necessary to do so before arrival of man in charge of system, who is always sent for as he is more familiar with valves."

Question 8. Do you require that sprinkler systems be put in commission, fused heads replaced, water turned on, before all firemen return to quarters?

Answers. Seventy-three per cent. do, and twenty-seven per cent, do not. Of those who do, 8 direct salvage corps to do it, and 2 a building employee.

Chief Hederman of Hornell, N. Y., says: "Yes, by all means, to avoid a possibility of fire re-kindling."

Chief Chase, Miami, Fla., says: "Yes, by all means. And if there are not any new heads to be found, we leave a hose company at the building until new heads are put in and the water turned on."

Responses from a few cities, where it is not required that sprinkler systems be put in commission before returning to quarters, follow:

Baltimore: "No. But it should be done, if possible."

Portland, Ore.: "No. We notify owner."

Columbus, Ga.: "Haven't done so, but such should be the case."

Wheeling, W. Va.: "The system is turned over to a watchman, who is responsible after we leave."

Appleton, Wis.: "No. But I advise putting systems in working order as soon as possible."

Rome, N. Y.: "A man detailed to remain at the building until water is turned on."

London, Ont.: "That is up to owners. At night they are notified by 'phone from headquarters."

Chicago Heights, Ill.: "We have never required it, but it is obviously a good provision."

Question 9. Do your men replace fused sprinklers with new heads and turn on water?

Answers. Fifty-eight per cent. say that their men do, and the rest that their men do not.

Of those whose men do replace fused sprinklers, 7 co-operate with salvage corps, 20 with building employees, and 2 with insurance inspectors. Three report that apparatus carries extra sprinkler heads.

Of those whose men do not replace sprinklers, the following say:

Chief Hurley, Holyoke, Mass.: "We have never done so, but would be willing to do it."

Chief Rose, Wheeling, W. Va.: "I approve of doing so."

In his report Chief Stanton draws the following conclusions from the replies received:

That for the most part sprinkler systems have fire department steamer connections.

That while a big majority of those responding thus far to the question sheets profess to use steamer connections, only one-half of this number, representing only 40 per cent. of the total of sprinklered buildings in territories where the connections are used, follow an unconditional practice of attaching hose to fire department connections of sprinkler systems when responding to alarms of fire in sprinklered buildings.

That only two cities heard from thus far — Chicago and Milwaukee — actually have a rule concerning the use of sprinkler system fire department connections.

That there is a sentiment in favor of a rule governing the fire department use of these connections.

That while in the jurisdictions of the 37 per cent. who do not use connections are only 17 per cent. of the total number of sprinklered buildings reported (most of them have less than 50 systems each), it is important that this minority give consideration to the practices of the majority who use these connections.

That while the majority of responses received report it is required that water shall not be shut off from sprinkler heads until it has been definitely found out that the fire is under control, 18 per cent., in whose territories are 16 per cent. of the sprinklered buildings, report to the contrary, and these few might well give ear to what Chief Boughner of Grand Rapids said: "We take no chances. It would certainly be a fatal mistake to do otherwise."

Several cases reported in the July, 1916, "Quarterly" of the National Fire Protection Association, show that it is a "fatal mistake to do otherwise."

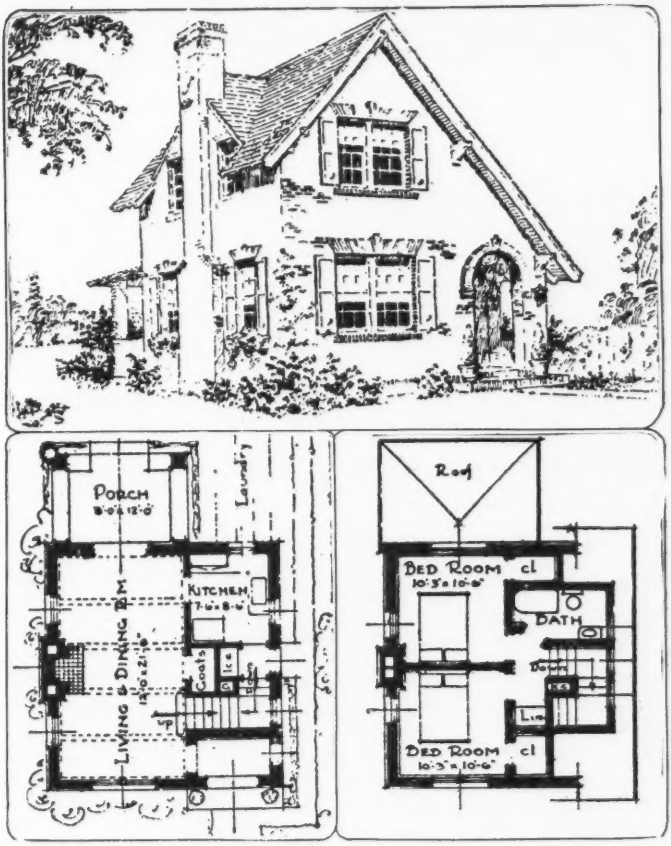
But the most serious fact of all is the following:

That 27 per cent. of those responding to the questions (most of them in the smaller cities) do not require sprinkler systems to be put in commission, fused heads replaced, and water turned on, before all firemen return to quarters.

Only this year, there have been several considerable fires in sprinklered properties because fires have re-kindled after firemen have returned to quarters without seeing to it that the sprinklers were put back into commission.

The Fire Chiefs' Convention continued the Committee which intends to confer with the Automatic Sprinkler Committee of the National Fire Protection Association regarding constructive suggestions concerning sprinkler systems made by individual fire chiefs in order to report on them fully at the next meeting.

Since compiling its report, the committee has received responses from several cities and towns, among them Cleveland, Washington, D. C., Fall River, New Orleans, Atlanta, and others that bring the number of sprinkler equipments to over 12,000, which will add to the attractiveness of the classification. The committee will endeavor to render a complete and final report at the next meeting.



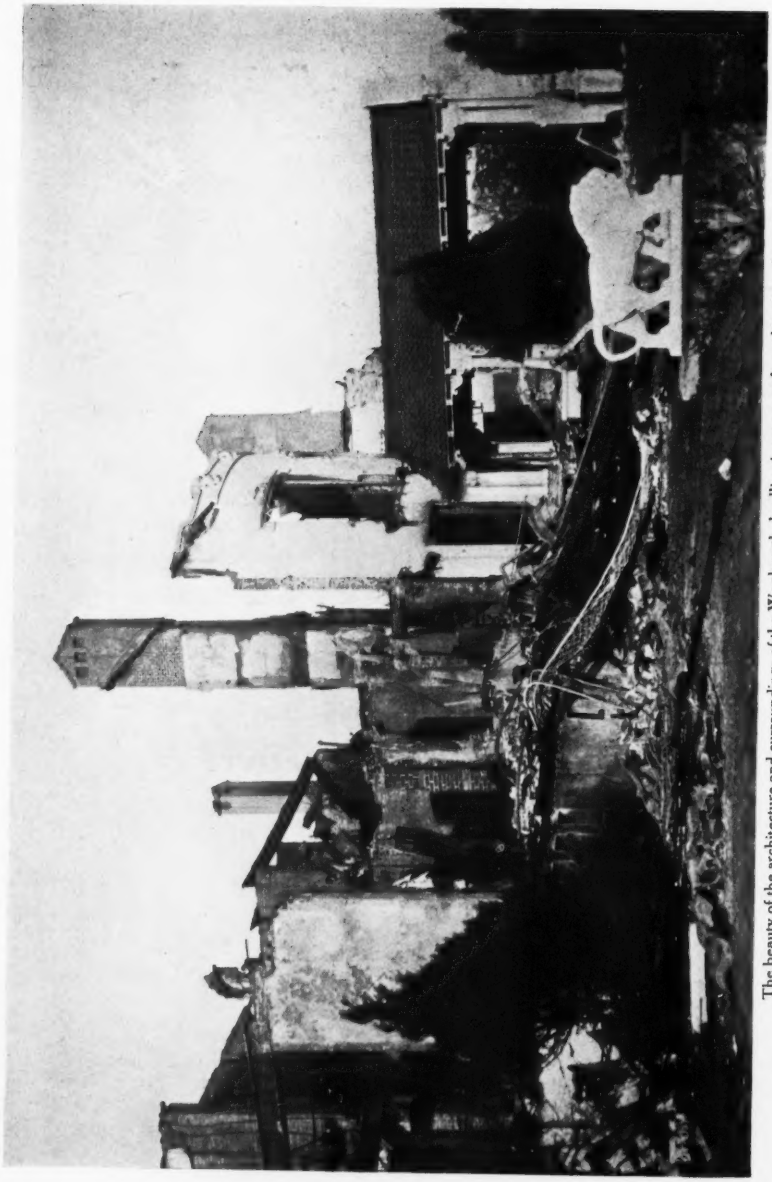
Home For Small Family.

One of the most effective branches of the government of the State of Minnesota is the Art Commission. This department is working in practical ways to encourage an appreciation of the artistic and is making it possible of attainment.

One of its activities is to provide practical homes of character, as a relief for the monotony of houses erected by speculative and by unskilled builders. Its first venture in this line was a competition for farm houses. This resulted in a portfolio of ideal homes for rural inhabitants, plans and specifications of which the Art Commission furnishes at cost.

Recently it undertook a similar competition for small homes of safe materials suited to narrow city lots. The little home in the accompanying cut is one of the products of this undertaking. It was one of the prize winners, as combining the best features both of exterior design and interior planning. A study of the plan will show that the maximum of accommodation has been obtained from the space available.

This little home is designed for the use of hollow tile faced with brick. Its cost is estimated at about $3,000.



The beauty of the architecture and surroundings of the Woolworth dwelling is apparent from this view of its ruins.

The F. W. Woolworth country residence at Glen Cove, Long Island, is the latest addition to the long list of high value dwellings which have been destroyed by fire in America. There appears to be reason for believeing that this fire was of incendiary origin.

Accurate Appraisals by Short Methods.*

By John G. Morse

Appraiser, Inspection Department, Associated Factory Mutual Fire Insurance Cos.

Inventories and appraisals of industrial properties have been in existence, to some extent, for many years. The earlier ones were crude and few in number. Modern methods of bookkeeping rendered inventories more necessary. For the purpose of fixing the amount of insurance to be placed and for carrying the plant as an asset, nearly all the larger manufacturing concerns finally had a home-made appraisal in one form or another. Personal inspection of a great number of these has led to the conclusion that the methods used were almost as numerous as the appraisals and that the accuracy varied as much as the methods.

With the advent of more elaborate cost systems and with the campaigns for efficiency, the need of more reliable work in this line became manifest. It was, therefore, but natural that appraisal companies should

* Paper read before THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

enter the field, offering to inventory property to the most minute detail and affix a value to each item.

But long before the first-mentioned practice of making home appraisals became at all common, the Factory Mutual Fire Insurance Companies inaugurated a system of making approximate valuations for the purpose of fixing the amount of insurance. From a beginning of a simple examination of the books of the assured, they soon took the shape of rough inventories, the appraiser using his judgment in affixing values to both buildings and contents.

As the Factory Mutual Companies developed their methods of making plans and inspections and their tests of fire preventing appliances to the complete forms in use today, so also did they develop the making of insurance appraisals.

At the present time these consist of inventories in as much detail as necessary to determine accurate values, while a system has been adopted for obtaining a reasonable estimate of all the minor items without going into elaborate detail.

These appraisals are made without cost to the assured and have been appreciated to such an extent that they are constantly used as a basis for bookkeeping and cost systems, for mergers and other business uses.

In explaining this method by which a large manufacturing plant can be accurately appraised in a very short time and with what seems like a comparatively small amount of work, I shall endeavor to show how useless it is to waste time on more laborious detail. It is an admitted fact that no appraisal can be made without incorporating many figures that are based simply on estimate. It is, therefore, needless to carry the detail in any direction where it will not add to the accuracy of the final result.

Disregarding new factories, where records of actual cost are easily available, let us consider an older plant and particularly one where no records of cost have been preserved. A building may be measured so carefully that the exact amount of each material is known. The market price of each material may be obtained. Yet, the amount for waste must be estimated and the amount for labor and all contingent expenses must be estimated.

The inventory of machinery may be made to the last trifling detail, yet the exact value can be obtained only for standard machines. Each special machine, as well as the cost for erection of every machine, must be estimated. Constant changes in market values always affect the accuracy of the result, but, aside from that, the amount of depreciation on both buildings and machinery must be estimated (or largely guessed at) before the actual present value is found.

The more experience one has in making appraisals, the more one realizes the truth of the above remarks and also that in making estimates the great law of averages counterbalances all minor errors.

A Method of Approximation

The method developed by the appraisal department of the Factory Mutual Companies I have been asked to explain. It is a method based entirely on the theory that if the larger factors are carefully appraised, the less important items may be estimated in groups.

The property to be appraised is divided into two parts, — buildings and machinery. The buildings are considered as empty structures. All elevators, piping, wiring and indeed anything that can be removed without altering the building, are classed under machinery. Attention might be called to the fact that in insurance appraisals, foundations and other underground work are ignored, but the method would be practically the same were they included.

Machinery is divided into machines proper, shafting, belting, piping, electric wiring and furniture and miscellaneous apparatus. Special small tools, dies, patterns, drawings, moulds, lasts and any objects of similar nature that exist in large quantities in the plant under consideration, are treated independently. The subject "miscellaneous apparatus," as its name implies, covers all objects of minor value not easily classified under any of the other heads.

The price values used for buildings and all the subdivisions of machinery are based on *replacing new at today's market* (regardless of original cost) and these price values are then depreciated as judgment dictates. I will explain our method of obtaining and applying new values before discussing the subject of depreciation.

Buildings

As stated above, by the term "building" we mean simply the empty structure. In appraising we use the square foot of floor area as a basis. Many architects and engineers use a factor based on the cubic foot of contents, but it is floor area that gives manufacturing facility, and the figures thus obtained are also useful in other parts of the appraisal as will be shown later. As a groundwork we use the tables prepared by Charles T. Main, Mem. Am. Soc. M. E. These must, of course, be changed for different heights of stud, degrees of finish, thickness of walls, etc., and also for constant fluctuations in the market value of labor and materials. As new factors are obtained for reinforced concrete and other modern forms of construction, the tables form a guide for consistency as lengths and widths vary.

It is in appraising buildings that the uselessness of extended detail is strikingly apparent. Those who have had occasion to call for bids are aware of wide variance in figures submitted. Suppose two identical buildings are constructed, one by the highest bidder and one by the lowest. They may be more than ten thousand dollars apart. Is the actual cost of either a fair appraisal figure? An estimate based on the square foot of floor area that showed a figure half way between the extremes would give a much more reasonable value. Indeed Mr. Main states that several

contractors have told him that they use his tables as a check before submitting bids.

The actual cost of foundations is far more unsafe to use for appraisal purposes. A building resting on extremely expensive foundations in quicksand is worth no more than a duplicate building resting on a ledge. A fair estimate for the cost of sufficient foundations in average ground would be a better figure to use for either when appraising an industrial property. With appraisals of public service corporations conditions are different, but that comparison is not to be discussed here.

Machines

It is our custom to make a complete inventory of all fixed machines, not only producing machines but those used for power and for maintenance. This inventory also includes all elevators and cranes. There is no hard and fast rule, but the practice is to list everything (exclusive of furniture, small tools, etc.) that has enough value to be worth considering separately. In making this inventory, the shortest description that will identify a machine is used. When ordering a new machine, detailed specifications are usually necessary, but to incorporate a long description in a list of machines simply serves to confuse when one is searching for an item and gives no real aid in determining the value.

As an example, for a cotton spinning frame "one ring frame 256 sp. 3″ met. bds. sep." means a ring frame with 256 spindles 3-in. gage, with metallic thread boards and separators. "One engine lathe 14 x 6 comp. taper" means an engine lathe with 14-inch swing, 6-foot bed over all, screw cutting, without special gearing, with compound rest and taper attachment. Other special features that materially affect the cost are, of course, noted. In each case the above brief notes are all that are necessary to determine the value of the machine in question. By adhering to this method the fixed machines in a large factory can be inventoried in a much shorter time than would be deemed sufficient by one not acquainted with the work.

Having completed the inventory, it is a simple matter to appraise standard machines either directly from price lists or from data compiled from individual quotations and actual costs obtained when making other appraisals. Of course, all such prices are given in confidence and are used without the source of the information being divulged. In the same way machines built on order or by the owner can be appraised as data on similar machines accumulate. Allowance is made in all cases for the cost of freight, cartage and labor of erection. It should be understood that no prices are fixed arbitrarily by the appraiser. On the contrary, the figures are discussed with the owner or manager and as much assistance as possible obtained from their records.

Approximation on Minor Items

The appraisal of buildings and machines forms the most important part of the work, both in time consumed and in results obtained. It would, therefore, be inconsistent to devote a greater amount of effort

to the smaller part of the value. It is here that accurate "short cut" methods have been developed in the appraisal department of the Factory Mutuals. The subjects will be described in the order mentioned earlier in this paper.

Shafting

By figuring in detail representative lines of shafting, with couplings, hangers and pulleys included, various factors per lineal foot erected have been obtained. Experience soon teaches which factor to apply when examining lines of shafting in actual use. Opportunities are repeatedly presenting themselves to compare the results obtained with those of a detailed appraisal, and the accuracy of the approximate method is confirmed.

Belting

The most satisfactory method by which belting may be rapidly inventoried is to measure the main belts by eye. The machine belts can then be classified in groups, as similar machines will require about the same amount of belting. Individual motor drives are lessening the amount of belting in a modern factory, and where the machines are scattered and the belts vary greatly, it is usually easier to list them by using eye measurement than to attempt to apply any shorter method.

Piping

It is probably needless to call attention to the fact that a detailed inventory of piping and pipe fittings would require an amount of time out of all proportion to that devoted to the remainder of the work. To obtain a "short cut" method has not been as easy as with shafting and belting, due largely to the fact that there is a much greater variety in the material to be considered and that much of it is hidden.

The different uses to which the piping is put enable the appraiser to divide the subject into classes and these classes can be treated by different methods.

Automatic sprinkler piping can be appraised at a price per sprinkler head or, by what amounts to the same thing, by a price per square foot of sprinklered floor area. This applies to the piping inside the buildings only.

Steam heating, where consistent throughout the plant, can also be appraised on a floor area basis. Where the amount of steam heat varies, a price per lineal foot of coil or per radiator can be easily ascertained. The heating pipe in dry rooms, lumber dry kilns, paper dry lofts, etc., can be treated in a similar manner.

Gas lighting is not common today, but where found can be appraised at a price per light. Where a building is provided with gas lights at frequent intervals, a factor per square foot of floor area can easily be estimated.

The piping used for manufacturing purposes presents the greatest difficulty. The steam and water pipe in a steam power plant will vary

little from a standard figure per horse power of boiler rating. For long runs of covered steam pipe through rooms where there are few or no outlets, a price per lineal foot can be used.

In plants where there is a great quantity of piping, particularly in bleacheries and paper mills, small factors cross-checked by large factors can be used. These factors are obtained from time to time when actual costs in a new plant are available. In all cases the large factor for steam is based on the horse power rating of the boiler plant. In a bleachery the large factor for water is based on the number of kiers; in pulp and paper mills, for water and stock piping, on the number of pulp grinders, digesters, wet machines and paper machines, as the case may be. The small factors in all cases are varied with the pieces of apparatus. By using both methods in estimating a plant a sufficiently accurate total can be obtained. With factories making dyes, chemicals, soaps, etc., the same method can be employed.

Air piping, though quite extensive in modern machine shops, never amounts to more than a very small fraction of the value of the plant. The runs of pipe are easily followed and a factor per lineal foot or per machine supplied can be ascertained.

Fuel oil and gas or gasoline piping is of still less importance from a value stand-point and can be easily estimated in a manner similar to that used with air piping.

Electric Wiring

Electric wiring should be divided into two main groups, one for lighting and the other for power. The number of light outlets in each room can usually be obtained from the electrician on the premises, and a factor per light applied to those of each size. The horse power of motors can be obtained from the inventory of machines. As it will cost more to wire several small motors than a large one equal in power to the others combined, they can be divided into two or more groups, according to conditions, and a factor applied to each group. A percentage of this total amount of both light and power wiring should be added for cables at the power house or, in cases where current is supplied from outside, at the transformer house. For electro plating wiring a factor per square foot of surface of plating tanks has been found accurate. For the wiring to electric welding machines, where these are supplied from a central dynamo, a factor per machine can be used. In plants manufacturing electrical apparatus a large amount of test wiring is found. Actual inventory of this can usually be avoided by consulting with the electricians in charge.

Furniture and Apparatus

In every plant there is a large amount of equipment (exclusive of small tools, dies, etc., which will be considered later) that cannot be classified under the head of machines and yet does not belong to any special class. This equipment is covered under the term "furniture and apparatus." It is a very elastic term, for with many of the items the

appraiser must use his judgment as to whether or not to list them in the machine inventory.

All furniture, benches, racks, trucks and scales come under this heading. In a textile mill all bobbins, spools, etc., in a metal working plant all boxes, trays and cans, indeed, every miscellaneous article that cannot be included under any other definite title, can be covered under this.

To list all of these items in detail would be an arduous task. Many would be destroyed and new ones added before the list could be completed. The value, however, would be insignificant when compared with the total value of the plant. It is not difficult, however, to obtain a fairly accurate estimate.

In a cotton mill a factor per spindle can be used and in a woolen mill a factor per set of cards. In any textile mill, however, it is possible to obtain from the different foremen the approximate number of bobbins, spools, roving cans, filling boxes and trucks, while the appraiser can easily estimate, room by room, the value of what other miscellaneous apparatus there is. In a metal working plant the benches and racks can be appraised by a factor per lineal foot; the number of tote boxes, cans and trucks can be obtained from the foremen, and the other miscellany can be estimated as above. A similar method can be applied to any plant. Office furniture can be appraised, without listing, by using judgment.

Small Tools and Dies

All machine shops contain an equipment of small tools and all metal working plants an equipment of dies. The proportion that the value of these bears to the value of the whole varies greatly with the class of work. In many concerns fairly accurate records are kept of the cost of such small tools and dies. Experience has shown that factors per producing machine can be used that will give a fairly accurate appraisal. Where a closer estimate is needed, the tool and die store rooms can be examined and fairly representative shelves or drawers can be appraised to obtain a factor or factors to be used for the remainder.

Patterns and Drawings

Depreciation plays an important part in finally determining the value of patterns and drawings, but, as mentioned above, this subject will be discussed later. To obtain the new value of patterns it may be possible to study the pattern shop pay roll for a given period and add a proper amount of overhead expense. So many patterns are obtained from outside, however, that the most satisfactory method is to examine the shelves in the pattern storage, classify them into a few groups and estimate a price per square foot of shelf area for each group.

With drawings, the pay roll, plus overhead expense covering the entire time since the drawings began to accumulate, gives the most accurate basis. For replacing cost, the present rates of pay should be used, but a deduction should be made for time spent in experimental

work in either case. A good cross-check is to obtain from the head draftsman the total number of drawings, divided into several groups for size and cost.

Moulds, Lasts, etc.

Moulds, used both for hard and soft rubber and in several other classes of manufacture, are usually carried on accurate inventory by the owner, but if not, they can be appraised by methods similar to those used for small tools and dies. Lasts in shoe factories, copper shells in print works, print rolls in wall paper factories and dandy rolls in paper mills are almost invariably carried on inventory. In the rare cases where not so listed they can be easily counted, divided into classes and an average price to be used for each class readily obtained.

Electrotypes

Electrotypes, wood cuts and similar objects used in printing offices, have a standard cost per square inch. As they are kept in drawers or on shelves it is comparatively easy to ascertain the total number of square inches of each kind.

Miscellaneous

The above mentioned subjects are the ones most commonly found. Occasionally the appraiser visits a manufacturing establishment which is out of the ordinary and special auxiliary apparatus is found in large quantity. By using some one of the methods described for appraising small tools, patterns, etc., the value of these extras can be obtained.

Stock and Supplies

In making insurance valuations the Factory Mutual appraisal department almost invariably relies on the inventories of the assured to obtain the value of stock and supplies. In rare instances, however, where such are not obtainable, a rough average obtained from previous appraisals of similar plants can be used.

Rough Approximation

The methods described above enable the appraiser to make an accurate estimate of the value of buildings and machinery in a much shorter time than would be used were all items listed in detail. To obtain quickly an approximate valuation, a comparison can be made with other appraisals on a basis of the square foot of floor area or of the number of producing machines. In specific instances the comparison can be made per spindle, per set of cards, per kier or per paper machine.

Depreciation

Depreciation, recognized almost universally today, has been considered in appraisal work only in comparatively recent years. There is a wide difference of opinion as to the amount of depreciation that should be allowed on buildings and various classes of machinery and as to the method of caring for such depreciation in the book accounts. Indeed,

another argument in favor of the "short cut" method of making valuations is the fact that two competent appraisers would show more difference in the value of a plant on account of varying opinions as to the amount of depreciation to be allowed than in errors made in estimating the new value.

There are also several kinds of depreciation. The greatest in amount is that applied to "second-hand" property and is governed by the desirability of the article or building under consideration rather than by its physical condition. A more conservative depreciation is applied in bookkeeping that the assets of a concern may be carried at a reasonable figure. The recent income tax law has brought the discussion of this subject more prominently before the public than ever before.

Depreciation for Insurance

A still more conservative depreciation is used for insurance purposes. A building that houses a going concern or a machine that is turning out a salable product deserves less depreciation from an insurance standpoint than from any other. It is the intention of the Factory Mutual Insurance Companies to deduct for depreciation what judgment shows is deserved for actual wear and tear and for obsolescence. The methods used in estimating this depreciation vary with buildings and with different kinds of machinery. In some cases a sliding scale can be applied and in others an average figure. These methods will be described in the same order as the methods of appraising for new value.

Depreciation of Buildings

A building badly out of repair naturally deserves fairly heavy depreciation. A building in good repair, but so antiquated in size and shape that it is manifestly unsuited for the uses to which it is being put, also deserves a reasonably heavy deduction. When, however, a building is of such dimensions that it perfectly answers its purpose, has remained plumb and is constantly kept in repair, actual age has little influence on judgment. It is considered that about five per cent of the new value is enough. In other words, buildings are not depreciated a certain per cent a year, but have a flat amount deducted on account of condition and not on account of age.

Depreciation of Machinery

Machines vary greatly both in the manner in which they wear out and in the rapidity with which they go out of date. In rare cases where a machine has been practically superseded in the market by one that will cost much less, it is better practice to use for a new value the cost of the less expensive machine rather than show an excessive depreciation. As a rule, the amount deducted applies chiefly to wear.

With machines that need repairs at all points from time to time, a day arrives after a period of years when it is better to throw them out altogether and replace with new rather than continue to repair them. Practically all textile machines come in this class, as do engines and other power plant machines, and also some machine tools, wood working

and paper working machines. To all of that nature a depreciation table is applied, allowing 2, 2½, 3, 4 or 5 per cent a year, deducted from the net and not from the gross. If a machine is entirely rebuilt, it is usually considered to be worth at that time within five per cent of new value and the table is applied for succeeding years. In either case, the probable average life is ascertained and the table that best fits is used, but seldom is the depreciation carried to a point beyond fifty per cent.

There are many kinds of machines where the main portion, sometimes as much as eighty per cent of the total value, remains for years with practically no wear. The small moving parts, however, wear so rapidly that they are constantly being replaced. This is true of a great variety of machine tools, metal, wood and paper working machines. With these it is considered that the wearing parts are always in a state of fifty per cent depreciation, and the amount deducted is half of the percentage the value of the wearing parts bears to the total value of the machine. This method also applies to rolling mills, rubber mills and calenders where the frames and gearing remain intact for years and the rolls constantly wear down and are replaced.

There is another class where neither the depreciation table nor the definite average described above can be used. This includes most of the machinery in paper mills, bleacheries and dye works where wet processes are used. These machines wear rapidly and are frequently rebuilt. Paper machines in particular are composed of a train of parts and from time to time different sections are either rebuilt or removed entirely and replaced. The depreciation in such cases depends upon the condition at the time of the appraisal and is not influenced by the age of what remains of the original machine.

Depreciation of Shafting, etc.

It is quite apparent that to obtain the age of shafting, belting, piping, etc., would in nearly all cases be impossible, so that general figures for depreciation are safest to use. Shafting shows such slight wear that depreciation is seldom recognized. It is becoming the custom, however, to show either a slight deduction or else purposely record the new value at a conservative figure when on account of poor arrangement an amount in excess of what is needed is in use.

Main belts wear slowly, while machine belts will always average fifty per cent wear, so that, as a rule, the total amount of belting is depreciated 33⅓ per cent.

Piping will last for years, except where exposed to acid fumes. Pipe covering and valves show wear, but piping as a whole is seldom depreciated more than ten per cent.

Electric wiring wears little and is usually kept pretty well up to date on account of the rigid rules of both local authorities and the insurance companies. It therefore seldom deserves much depreciation.

The miscellaneous equipment classed under the head of "furniture and apparatus" is made up of objects most of which are constantly wearing out. The amount is, therefore, usually depreciated from twenty to fifty per cent.

Small tools, dies, print rolls and electrotypes wear out, but they are affected to a great extent by obsolescence. Patterns, drawings, moulds and lasts are subject to depreciation for the latter reason only. In determining the amount to be deducted from the new value of any of these the appraiser must ascertain what proportion of the equipment is indispensable or practically new.

Appraisal Companies

Having explained the method by which an accurate appraisal can be made, expending the minimum amount of time, the writer may well refer briefly to the method of making an appraisal by laborious, painstaking detail. This method is best illustrated by the work of the appraisal companies. It is perhaps needless to remark that as the Factory Mutual Fire Insurance Companies give the services of their appraisers without extra charge to the assured, they are not to be regarded as in competition with anyone.

Opportunity has been given again and again to examine the records and the results of such appraisals. The finely prepared volumes are found to contain a list of substantially everything on the premises. They are overburdened with extended descriptions of buildings and machinery, far more than is necessary to determine value and decidedly confusing to the searcher for individual items. The usual proportion of the total value recorded is based on estimate only and invariably there are errors large enough to counterbalance whole pages of minor items so carefully noted. The law of averages usually balances these errors, so that the final result is approximately correct, but no more so than that of an appraisal made by the shorter method already described.

Court Cases

It has often been stated that the courts will not accept a valuation unless made in detail. One has but to demonstrate how largely estimate must enter into every appraisal, regardless of the method used, to prove that the shorter can be as accurate as the longer. Although the Factory Mutual Fire Insurance Companies have always endeavored to avoid giving testimony in court, circumstances have compelled such service on rare occasions and the results have been in every case satisfactory.

In Conclusion

This so-called approximate or "short cut" method of making appraisals has been employed by the Factory Mutuals for a long period of years and, as has been explained, foundations and other uninsurable properties are omitted, while the depreciation charged off is for insurance purposes only. It should be emphasized that the figures thus obtained are not intended for other uses, though safe enough for proportioning a cost system. But the method described can be employed in making an appraisal for any purpose whatever by extending it to cover all property, whether or not insurable, and increasing the depreciation to a point more in accord with book-keeping methods.

Department of Fire Record.

Warehouses and Storehouses—Fire Record.

Warehouses and storehouses present certain obvious difficulties in the matter of a fire record. A storehouse may be anything from a neglected wooden shed erected in an untidy factory yard to a fire-resistive building equipped with the best of mechanical fire-fighting appliances and guarded by an efficient watchman service. The contents of a storehouse, also, may be of almost any material from celluloid to asbestos. Nevertheless, an examination of the record of fires in properties of this class discloses some interesting facts which are of fairly general application. Cotton warehouses, having formed the subject of a study by themselves in the QUARTERLY of October, 1911, are not included in the present record. Storehouses for wool and for tobacco, together with cold storage plants, are also excluded.

The first striking fact to be noted with regard to storage fires is that 45 per cent. are attributed to unknown causes. That the proportion of unknown causes should be high is only what we should expect. The comparative solitude of the warehouse affords exceptional opportunities for undetected acts of carelessness or malice; but, when all has been said, the present figure seems altogether excessive, and should be susceptible of considerable reduction through better housekeeping, superintendence and watchman service. Another circumstance which suggests the urgent need for a more vivid realization by warehouse proprietors of the seriousness of the fire hazard is made apparent by a comparison between the figures relating to all warehouses and to sprinklered warehouses, respectively. The value of the automatic sprinkler is particularly great in a class of property in which there is more than the usual likelihood of delay in the discovery of fire and in which the presence of closely packed goods may hamper the firemen's efforts to reach the seat of fire. Yet, notwithstanding the fact that no more than 16.6 per cent. of the fires in sprinklered properties were reported as entailing a large loss, compared with 46 per cent. in sprinklered and unsprinklered together, the large majority of warehouses would seem to have no sprinkler equipment.

Foremost among the known causes is spontaneous combustion of stock, which accounts for 57 fires, or 12.6 per cent. of the whole. Damp hay and grain, baled rags, paper, jute and wool and cotton waste were responsible for most of these fires. The smoking hazard is inevitably

somewhat high, including as it does, much smoking by the most reckless classes in the community—tramps and small boys—who have a habit of loitering about premises of this sort. The "locomotive spark" hazard is very difficult of elimination owing to the necessity of locating warehouses close to railway sidings; but it may be greatly reduced by substituting non-combustible roofing for the wooden shingles that are now far too common. A word should also be said on the subject of the lighting of warehouses. The greatest care is at all times necessary in the use of portable appliances. Matches and open candles should never be used; lamps should always be lighted and extinguished outside the warehouse. There are distinct advantages in having such buildings lighted by electricity, as this method gives least opportunity for human thoughtlessness to cause trouble; but all wiring, etc., should be done by competent workmen in accordance with the National Electrical Code. If accidents with matches, candles and lamps were the cause of a number of fires, so also was poor workmanship on the part of careless or incompetent electricians. This remark, of course, applies also to wiring in connection with electric power.

Good housekeeping and general superintendence are of the highest importance in removing the occasions of fire, as well as in facilitating the work of extinguishment should fire occur. The broken window, the littered floor, the badly arranged stock without adequate and properly planned aisles, neglect to close gates and to keep doors locked, are all very important factors in the warehouse fire hazard. Generally speaking, a warehouse is not a suitable place in which to allow employees to eat their lunch; still less is it a desirable place to which to retire for a quiet smoke. The crying need of many warehouses seems to be for more regular visitation by watchmen and superintendents and less irregular visitation by casual outsiders.

The information available regarding causes of fires in warehouses is less detailed than in many other classes of property, and the quotations from fire reports under this head have consequently been limited to fires due to lighting, as these seemed to be the only class in respect of which such a heading would be of value. Incidental references to other causes will be found among the "points of interest", in which defects of superintendence and housekeeping are illustrated.

The sprinkler tables present the somewhat unusual feature of dealing with wet and dry pipe sprinkler systems in approximately equal proportions.

WAREHOUSES — FIRE RECORD.

Total Number of Fires Reported, 834.*

1. Classification of Causes.

Common Causes.

	No. of Fires.	Per Cent. of Common Causes.	Per Cent. of Known Causes.
Heating	19	6.5	4.2
Lighting	31	10.5	6.8
Power	22	7.5	4.8
Lightning	12	4.1	2.6
Smoking	47	16.0	10.4
Locomotive Sparks	44	15.0	9.7
Matches	21	7.1	4.6
Boiler (or fuel)	13	4.4	2.9
Rubbish (or sweepings)	22	7.5	4.8
Oily Material	23	7.8	5.1
Miscellaneous	40	13.6	8.8
	294	100.0	

Special Hazard Causes.

	No. of Fires.	Per Cent. of Special Hazard Causes.	Per Cent. of Known Causes.
Stock fires	57	62.6	12.6
Miscellaneous	34	37.4	7.4
	91	100.0	

Common Causes	294		64.8
Special Hazard Causes	91		20.0
Incendiary	39		8.6
Exposure	30		6.6
Total Known Causes	454		100.0
Unknown Causes	380		
Total	834		

*Data from 67 Fire Patrol Reports, used here and in Table 3, not sufficiently complete for use in all the tables.

Details of Causes.

Lighting.

S-7031. Heavy wire guard lanterns, burning signal oil, were used in this warehouse to give light when bales were being stored away in the middle of the building, and for lighting the elevators, etc. One of the employees had just brought several bales of horse blankets and a lantern up on the elevator to the fourth floor, the bales were pulled into the aisle on that floor and the lantern was set on the top of a bale. Turning quickly, one of the men employed in moving the goods knocked the lantern over with his elbow, breaking the glass globe and sending the lantern to the floor. Oil ran out over the burlap wrapping of the bale, caught fire from the burning wick, and blazed up halfway or more to the ceiling. There was only a slight loss, owing to the prompt action of the employees and the operation of sprinklers.

S-9188. Fire started in the ceiling of the boiler room between the joist channels in which electric wires ran. The wiring was rather loosely put up, and after the fire it was noticed that there appeared to be a slight discharge from the electric system. The operation of three sprinklers confined the fire to an area of about four square feet and the damage was slight.

H-4645. It is supposed that a packer left a lighted candle standing on a box. The loss exceeded $27,000.

H-7470. A carpenter employed by the firm to do all ordinary repairs placed a lantern and two lighted candles on the flooring of the first story, where he was at work. On leaving his work for the day, he took the lantern, but forgot the candles, which continued to burn until the flooring was ignited.

S-12639. Two boys had been sorting wastepaper by candle light in a small underground room cut off from the basement of the main building by automatic fire doors. The boys brought the candle out with them, but a few minutes later smoke was observed escaping past the fire door. The blaze was extinguished with a small hose and chemical extinguishers. The loss was trifling.

H-8462. This fire is attributed to the explosion or dropping of an oil lamp provided for the use of the night watchman, the electric current being turned off at night. The fire originated in the office which the watchman made his headquarters, and the watchman, who was over 70 years of age and had a weak heart, was overcome by the smoke, his body being discovered by the day watchman on his arrival next morning. The office doors and windows were fairly tight, and for want of air the fire only smouldered through the night, destroying a portion of the office

furniture and charring the remainder. A large quantity of tea stored near the office suffered damage by smoke.

H-8661. In this case a loss of more than $12,000 resulted from an exposed electric light wire on a wooden ceiling. The spread of fire was facilitated by an open elevator in the center of the room.

H-9774. An employee set down a lantern in the section of a storage warehouse which was used for storing bales of cotton. A passing truck jarred a bale which had not been set upright, and this fell on the lantern and was ignited. Twenty-three bales were damaged before the fire was extinguished.

H-10100. The management of a storage warehouse had been informed that their electric wiring was unsafe. They took no action, and a fire involving a loss of $170,000 resulted.

H-10787. Defective electric wiring, to which the attention of the management had vainly been drawn, caused a loss of more than $30,000.

S-17523. This fire occurred alongside a pile of felt horse collars near a stair shaft door. Two watchmen were employed, and it is thought possible that one of them placed his lantern against the pile while he opened the iron door on the stair shaft. An alternative suggestion is that the watchman dropped hot ashes from his pipe. The loss was mainly due to water damage.

S-18073. Wall paper was stored in bundles (about 50 rolls to the bundle), these being piled six high on end. A shipping clerk was getting out an order, and although the room is lighted electrically it was found necessary to use a kerosene lantern to identify the packages. This lantern was set on the floor and overturned by a falling bundle of paper. The flowing kerosene ignited and set fire to the stock. One sprinkler opened and was controlling the fire; but a hose stream was used and a considerable quantity of water discharged on the floor. As the stock was not skidded, much of the stock was wet on the ends. The water ran through the floor and damaged some paper on the story below. The total loss was between $3,000 and $4,000.

MISCELLANEOUS STATISTICS.

2. Analysis of Loss.

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
No Claim	31	14	7	10	24	6	62	9
Small Loss	117	54	43	59	143	37	303	45
Large Loss	71	32	23	31	217	57	311	46
Total with data given	219	100	73	100	384	100	676	100
No data	28		2		61		91	
Total	247		75		445		767	

3. Day or Night Fires. (Day Fires 6 a. m. to 6 p. m.)

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Day	157	56	43	48	156	37	356	45
Night	123	44	47	52	262	63	432	55
Total with data given	280	100	90	100	418	100	788	100
No data	14		1		31		46	
Total	294		91		449		834	

4. How Discovered.

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Employee	86	36	31	43	111	27	228	32
Watchman	35	15	17	23	69	17	121	17
Thermostat	1	1	..	..	3	1	4	1
Sprinkler Alarm	28	12	4	6	20	5	52	7
Outsider	77	32	20	27	201	49	298	42
Supervisory	9	4	1	1	1	1	11	1
Total with data given	236	100	73	100	405	100	714	100
No data	11		2		40		53	
Total	247		75		445		767	

SPRINKLER FIRE RECORD*.

5. Effect of Sprinklers.†

	No. of Fires.	Per Cent. of Whole
Extinguished or Practically Extinguished Fire	141	68.8
Held Fire in Check	51	24.9
Unsatisfactory	13	6.3
Total	205	
No Claim	38	18.5
Small Loss	133	64.9
Large Loss	34	16.6
	205	

6. Number of Sprinklers Opened.

No. of Sprinklers Operating.	Extinguished Fire.		Held Fire in Check.		Unsatisfactory.		Total	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No of Fires.	Per Cent.
1	57	40.7	6	12.5	..	..	63	32.6
2	20	14.3	2	4.2	..	..	22	11.4
3	22	15.7	4	8.3	1	20.0	27	14.0
4	10	7.1	6	12.5	..	..	16	8.3
5	4	2.9	3	6.2	..	..	7	3.6
6 to 9 incl.	11	7.9	7	14.6	1	20.0	19	9.9
10 to 24 incl.	7	5.0	9	18.8	1	20.0	17	8.8
25 to 49 incl.	7	5.0	4	8.3	1	20.0	12	6.2
50 and over	2	1.4	7	14.6	1	20.0	10	5.2
Total	140	100.0	48	100.0	5	100.0	193	100.0

No. of Sprinklers Operating.	No. of Fires.	Per Cent of Whole
1	63	32.6
2 or less	85	44.0
3 or less	112	58.0
4 or less	128	66.3
5 or less	135	69.9
Less than 10	154	79.8
Less than 25	171	88.6
Less than 50	183	94.8
50 and over	10	5.2

*There were 39 fires in which the heat was insufficient to open any sprinklers.

†Twelve fires included in this table are omitted from subsequent tables owing to insufficiency of data.

Points of Interest from Fire Reports.

Automatic Sprinklers.

S-8127. This was an incendiary fire, set by the insertion of a piece of lighted waste, soaked in oil, under a door. The warehouse, which was of plank and timber construction, was used for the storage of cattle hair in bales, starch in barrels, etc. The watchman had been in the room in which the fire occurred shortly before, and found everything all right. When on the second floor of the adjoining building, he heard the sprinkler alarm ringing and also the low air alarm attached to the system. The annunciator indicated where the system was in operation, and going thither the watchman found three sprinklers discharging along the wall. It is claimed that he was unable to discover any smoke or fire, and shut off the system after the sprinklers had been operating for about twenty minutes. The fire seems not to have been discovered until about a fortnight after its occurrence, when, on the removal of some wet bales of cattle hair, the charred door was discovered. There was no evidence of fire on the outside of the building, but the inside of the door was charred for about half its width. The flames had risen and scorched the ceiling slightly on one spot, opening the sprinklers. The very slight delay required for the dry valve to trip, after the sprinklers opened, probably accounts for the scorched spot on the ceiling. The bales were piled up near to the wall. There was a small bay, 14 inches in width, between the end timber and the west wall, and this bay was protected with a line of sprinklers, one head being almost directly above the door at which the fire originated. **The sprinklers were very effective, and the case illustrates the importance of protecting such small bays, especially along a wall of building.** The loss was almost entirely due to water damage to bales of cattle hair and wool. The first floor was partly open, and water ran down upon bales in the basement.

S-11877. Fire occurred in a hardware warehouse on the top of a pile of glass in crates packed with hay and excelsior, directly underneath a board about 2 feet wide by 6 feet long. The cause was spontaneous combustion in rags used by employees for wiping their hands after filling cans with linseed oil, dryers, etc., for distribution. One sprinkler opened and held the fire in check, but could not entirely extinguish it, owing to the protection afforded to the burning material by the board above mentioned. The dense smoke prevented the firemen from immediately determining the extent of the blaze, and it was consequently necessary to allow the sprinkler to continue discharging water. The floors were not waterproofed, and the damage amounted to about $10,000.

This fire strikingly illustrates the desirability of paying attention even to slight obstructions which may hamper the distribution of water by sprinklers in the event of fire.

S-14894. Fire was observed on the outside of a frame storage building equipped with sprinklers. The prompt operation of the sprinklers prevented the fire from burning through the wall.

S-19391. Roofed platforms eleven feet wide extended along both the north and south sides of the warehouse. These were used for the storage of baled waste papers and burlap; also as sleeping porches by tramps. The latter use was undoubtedly the cause of fire which burned the roof and window and door frames, but which was prevented from getting a start within the building by a line of eighteen sprinklers which formed an effective water curtain until the arrival of the fire department.

Watchman.

H-4256. An employee slept in this agricultural implement warehouse, but he had no regular rounds. He discovered the fire on the second floor when he left the outside steps on which he had been sitting to take the air preparatory to retiring. He turned in an alarm but by the time the firemen arrived the fire had gotten beyond control. The floor openings were unprotected, and the roof and two upper floors fell in and destroyed all the stock on three floors. The total loss was estimated to exceed $95,000.

H-6414. This was a storehouse for hay and grain and general river freight. The fire started inside the warehouse and was not discovered until beyond control. The only watchman service was by an outside watchman who also kept under observation a number of other properties. The loss was practically total.

H-7255. In this case an entire section of a molasses warehouse was burned out with a loss of about $280,000. Fire walls and fire doors kept the fire from spreading to adjoining sections. In the burned section, which was mainly one story, wood construction, only the boiler room remained, this being of fire-resistive construction. The fire occurred on Sunday morning about half an hour after the day watchman should have arrived. No message was sent by him to the supervisory system. No word having been received from the watchman after the receipt of the trouble signal, a runner was dispatched. When the runner arrived he found the watchman on the premises, and the latter explained his neglect to turn in his rounds by saying that he had been fighting the fire. It seemed clear, however, that he had not been on duty prior to the fire.

H-10141. The prompt action of a small Italian boy in discharging seven extinguishers upon the fire saved this varnish warehouse from destruction. The plank and timber roof was just taking fire and varnish tanks nearby were becoming hot. The watchman was an old man and was of only nominal assistance.

H-11438. Fire occurred in an unsprinklered frame shed used for the storage of cotton yarns in bales in the corner of the yard of a dyeing and bleaching plant. It was attributed to smoking by boys who could obtain

ready access through the open gate of the yard. The blaze was promptly discovered and extinguished by the watchman with buckets of water, of which there was a supply in the shed.

This fire is a good illustration of the value of having watchman stations in such buildings as yard stock sheds and also of providing fire pails in such locations.

Roofing.

H-8402. This was a wooden shingle-roofed storage shed for lumber and wagons. Burning embers were carried by the wind for a mile, where they caused explosions in powder mills. The storage shed itself and an adjoining building were a total loss.

H-10674. A loss of more than $27,000 was caused by sparks from a chimney falling on the shingle roof of a hay, grain and flour warehouse.

H-11369. Fire was discovered in the roof of a storage shed at a cotton waste mill. The roof was covered with inferior roofing paper, and under the influence of a high wind the fire spread so rapidly that nothing could be done to save the building. The total loss exceeded $30,000.

The above fires are only samples of a large number which emphasize the unsuitability of combustible roofs for warehouse buildings.

Concealed Spaces.

S-6915. Fire involving a loss of about $4,000 originated in an enclosed space, about 18 inches deep, between a raised platform and the floor. This space was not protected by sprinklers and the platform collapsed, carrying a part of the first floor into the basement.

S-19045. From an unknown cause, rubbish ignited under the floor of a copra warehouse, and spread to oily joists and piles on which the floor was laid over the tidewater. The fire was a blind one and difficult to reach. Sprinklers opened, but inasmuch as there was hardly any fire in view, and the water was only damaging the stock, and the alarm was an annoyance, the water was shut off, and the outside sprinklers set in operation with fair results. The stock was in close, deep piles, which further hampered efforts at extinguishment. There was a heavy loss.

Vertical Openings.

H-2790. Fire occurring in a general storage warehouse, while the employees were out at lunch, resulted in a loss of $65,000. The fire was not immediately discovered, and the rapidity with which it spread is attributed largely to the presence of unprotected floor openings.

H-5993. A two-story furniture warehouse, with its contents, became a total loss. When the fire department arrived, the fire was on the first story only, but owing to lack of protection for the vertical openings, it was impossible to save the building.

H-5766. Fire communicated rapidly by means of a frame elevator shaft from first story to third. Loss amounted to about $14,500.

H-7052. This was a warehouse of joist construction used for the storage of baled cotton waste, excelsior, etc. There were no inside stair-

ways or other floor openings, and largely for this reason the fire did not reach the second floor. Good brick walls prevented the lateral spread of fire.

H-6480. At the southwest corner of this large warehouse was a hatchway or hoist (without elevator or car) entirely open in front except for safety gates, boarded in on two sides, with the brick wall of the building at the back. Adjoining this hatchway was an open stairway, and both extended from the basement to the top floor. There were other unprotected openings. Fire occurred on second floor, traveled rapidly to the hatchway and stairway, and speedily reached all floors to the top and the building was doomed.

Housekeeping and Superintendence.

H-1549. Fire is supposed to have been caused by boys who had been permitted to make a practice of sitting in the doorway and smoking.

H-2728. A loss of more than $2,200 is attributed to a broken window through which a locomotive spark ignited hemp inside the warehouse.

H-4908. Fire occurred in the office on the second floor of warehouse. A young stenographer overturned with her foot or dress the kerosene oil stove used for heating purposes. Fortunately there was a fire station very near, and the blaze was quickly under control. **Oil stoves are, however, quite undesirable means of heating.**

H-5393. A grain and feed warehouse became a total loss owing to the dropping into the yard of a ball of excelsior saturated in oil from a toy balloon. The yard was in an untidy condition and fire spread to the building from loose hay scattered about the rear door.

S-11465. Fire was caused by tramps smoking in hay loft. One was burned to death.

H-9843. Fire involving a loss estimated at $38,000 broke out in a general storage warehouse at about 9.15 p. m. There had been a small fire the same afternoon in a lot of household furniture stored in the building, but this had been promptly extinguished by the fire department. Instructions had been given to place a special watchman in the premises for the night, but the manager decided to leave the care to a block watchman who was to enter the building every 30 minutes. This man found all well at 8.30 p m., but on returning at 9 o'clock could not work the lock even after summoning the aid of the police. The fire was discovered about 15 minutes later.

S-13287. This fire entailed a heavy loss from water damage to bales of jute and hemp, mainly as a result of failure to leave clear spaces or aisles on all sides of the bales. The fire worked its way into numerous concealed spaces and was very difficult to extinguish.

S-14757. Paper was stacked in large high piles, without adequate alleyways. Fire started at the bottom and was very difficult to extinguish, with unnecessary water damage as one of the results.

7. EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires. Extinguished fire (or practically extinguished)		Held fire in check		Unsatisfactory		Average Pressure. Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Average Number Sprinklers Opened. Extinguished fire (or practically extinguished)	Held fire in check
Water works,	89	46.1	67	17.69	60	67.4	25	28.1	4	4.5	63	75	66	5.87	46.08
Gravity tank,	38	19.7	36	11.21	27	71.1	11	28.9	....	....	36	35	....	10.37	13.27
Pressure tank,	47	24.4	97	2.80	40	85.1	6	12.8	1	2.1	96	100	100	2.75	3.17
Automatic pump,	19	9.8	82	7.00	13	68.4	6	31.6	....	....	85	74	....	6.38	8.33
Total	193	100.0	69	11.66	140	72.5	48	24.9	5	2.6	70	69	73	5.89	28.48

8. EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires. Extinguished fire (or practically extinguished)		Held fire in check		Unsatisfactory		Average Pressure. Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Average Number Sprinklers Opened. Extinguished fire (or practically extinguished)	Held fire in check
Less than 15 lbs.,	2	1.0	11	4.50	2	100.0	....	.....	....	....	11	....	....	4.50	.....
15 to 24 inclusive,	11	5.7	19	13.00	8	72.8	3	27.2	....	....	19	19	....	8.25	25.66
25 to 49 inclusive,	40	20.7	37	9.52	32	80.0	8	20.0	....	....	37	36	....	9.44	9.87
50 and over,	140	72.6	84	12.29	98	70.0	37	26.4	5	3.6	86	80	73	4.57	32.73
Total	193	100.0	69	11.66	140	72.5	48	24.9	5	2.6	70	69	73	5.89	28.48

9. EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires. Extinguished fire (or practically extinguished)		Held fire in check		Unsatisfactory		Average Pressure. Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Average Number Sprinklers Opened. Extinguished fite (or practically extinguished)	Held fire in check
Wet system,	83	43.0	69	3.91	65	78.3	16	19.3	2	2.4	70	67	67	2.83	8.31
Dry system,	110	57.0	69	17.52	75	68.2	32	29.1	3	2.7	69	69	76	8.55	38.56
Total,	193	100.0	69	11.66	140	72.5	48	24.9	5	2.6	70	69	73	5.89	28.48

10. EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS —As Regards Amount of Loss.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires.						Average Pressure.			Average Number Sprinklers Opened.		
					No claim		Small loss		Large loss		No claim	Small loss	Large loss	No claim	Small loss	Large loss
Water works,	89	46.1	67	17.69	12	13.5	62	69.7	15	16.8	66	66	71	3.58	12.41	55.08
Gravity tank,	38	19.7	36	11.21	4	10.5	27	71.1	7	18.4	47	36	29	3.75	6.85	32.28
Pressure tank,	47	24.4	97	2.80	18	38.3	27	57.4	2	4.3	96	96	105	1.47	3.37	6.50
Automatic pump,	19	9.8	82	7.00	3	15.8	15	78.9	1	5.3	97	79	78	3.00	7.47	12.00
Total	193	100.0	69	11.66	37	19.2	131	67.9	25	12.9	81	67	62	2.56	8.78	42.04

11. EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS —As Regards Amount of Loss.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires.						Average Pressure.			Average Number Sprinklers Opened.		
					No claim		Small loss		Large loss		No claim	Small loss	Large loss	No claim	Small loss	Large loss
Less than 15 lbs.,	2	1.0	11	4.50	....	....	2	100.0	....	.....	....	11	....	.....	4.50	.....
15 to 24 inclusive,	11	5.7	19	13.00	1	9.1	7	63.7	3	27.2	18	19	18	9.00	6.43	29.66
25 to 49 inclusive,	40	20.7	37	9.52	5	12.5	29	72.5	6	15.0	39	36	39	5.60	6.86	25.66
50 and over,	140	72.6	84	12.29	31	22.2	93	66.4	16	11.4	90	82	79	1.83	9.67	51.71
Total	193	100.0	69	11.66	37	19.2	131	67.9	25	12.9	81	67	62	2.56	8.78	42.04

12. EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS —As Regards Amount of Loss.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number and Per Cent. of Fires.						Average Pressure.			Average Number Sprinklers Opened.		
					No claim		Small loss		Large loss		No claim	Small loss	Large loss	No claim	Small loss	Large loss
Wet system,	83	43.0	69	3.91	16	19.3	58	69.9	9	10.8	83	67	63	1.50	3.42	12.25
Dry system,	110	57.0	69	17.52	21	19.1	73	66.4	16	14.5	80	68	62	3.40	13.03	57.93
Total	193	100.0	69	11.66	37	19.2	131	67.9	25	12.9	81	67	62	2.56	8.78	42.04

Note—"Average number of sprinklers opened" does not in any case include the Unsatisfactory fires.

General Fire Record

Fire at Plant of Oakes Manufacturing Company, Long Island City.

Special Joint Report by New York Board of Fire Underwriters and New York Fire Insurance Exchange.

Construction

The plant of the Oakes Manufacturing Company is located opposite Seventh (Blackwell) Avenue, Long Island City, on the point of land bounded by that portion of East River known as Bowery Bay on the northeast and Berrians Creek on the northwest.

The plant consists of a main group of buildings, Nos. 1 to 14, of frame construction, with the exception of a minor portion which is of brick and corrugated iron on steel frame; all buildings, except the brick buildings, communicate by frame partitions or unprotected openings; the brick building has, however, sub-standard fire doors on one side of wall at all openings.

Directly to the rear of the main group of buildings is a group of two frame buildings, Nos. 18 and 19, covered on the outside with corrugated iron. In these buildings the fire originated and to them it was practically confined.

About 35 feet east of these two buildings was a group of three more frame buildings, Nos. 15, 16 and 17, the latter of which only was damaged by fire.

Building No. 19 which was destroyed by fire, was 32 feet wide and 184 feet long. It was originally constructed as a one story building but was recently raised to two stories; the walls were wood sheathed and covered on the outside with corrugated iron; floors were in part double with one-inch hardwood on rough floor, otherwise two-inch plank, all on joisted construction. The second story was divided into three sections by partitions of wood, as shown on plan attached. The first story — together with building No. 18 — was one undivided area.

Building No. 18 was recently built. It was of similar construction to No. 19 and was 61 by 64 feet in size. As noted above, it was open to No. 19 on the first floor and communicated through a frame partition on the second. Floor openings in these two buildings consisted of one inside stairway — said to have been enclosed in wood, metal covered — and an open escalator for barrels, both of these being located in Building No. 19. There are three outside iron stairways located as shown on plan, giving access to and available as fire escapes from the second floor.

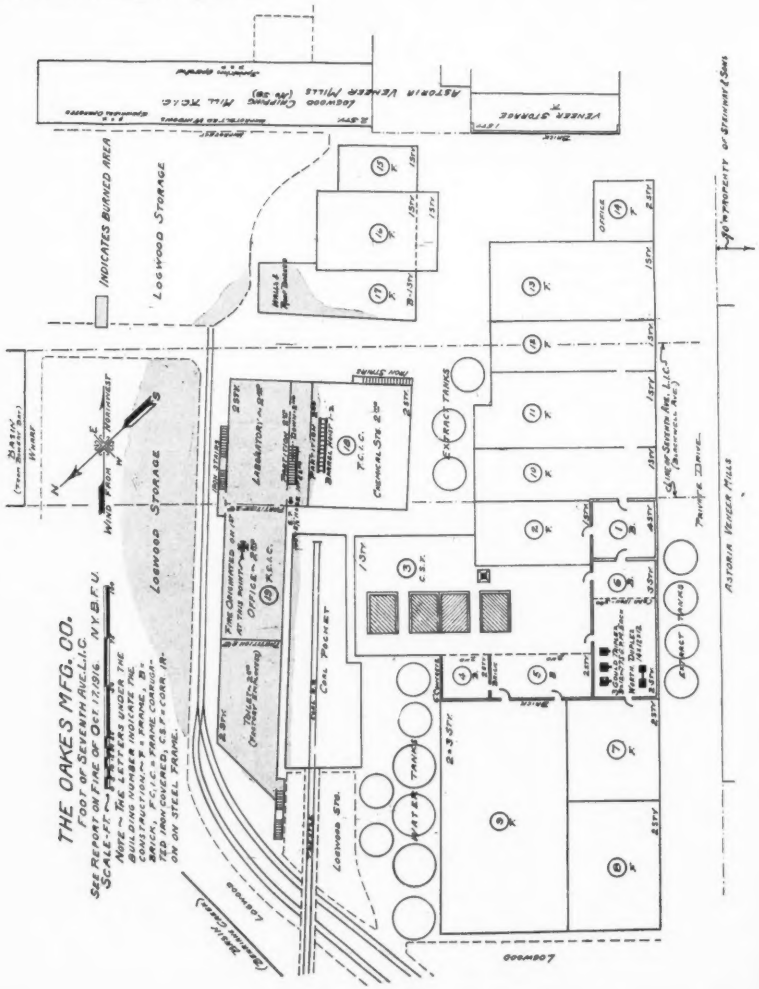
Occupancy.

The plant as a whole is occupied for the extracting of natural dye colors from logwood and fustic, these processes being carried on in the main group of buildings.

Buildings Nos. 18, 19 and 17 were occupied as follows:

No. 18—First floor, storage of finished logwood and blending of natural colors. A portion was partitioned off and used for storage of mill supplies. Second floor, storage of chemicals, principally common salt in barrels.

Building No. 19 — First floor, storage of logwood, fustic bark and sumac extracts in barrels, also storage of a variety of chemicals necessary in the processes of manufacturing the dyewood extracts. Second floor, toilet for factory employees; general offices, laboratory, used principally for the testing of dye stuffs.



Building No. 17 — Storage of new empty barrels.

Yards at north and east of Buildings 19 and 17, logwood and fustic piles, about 30 feet high, reaching to the property of the Astoria Veneer Mills.

Fire Protection.

The Oakes Manufacturing Co. — The plant of the Oakes Manufacturing Co. was provided with a liberal supply of casks, pails and 2½-gallon chemical extinguishers, well distributed. In addition to these there were standpipes and hose systems as follows: Salt Water System recently installed. A system of overhead wrought iron piping consisting largely of 2½-inch, but increasing in some locations to 3 and 4-inch pipe, with outlets fairly well distributed about plant, used for fire puposes only, and supplied by a 14 x 12 x 12 pump, bronze fitted throughout, which is also used for service purposes and when so doing maintains a pressure on system of about 20 pounds: Fresh Water System of 2½-inch overhead wrought iron pipe, increasing to 3 and 4 inches in some locations, used also for service purposes and supplied through a 4-inch metered City connection, giving a static pressure of about 40 pounds per square inch. There was also a Condensing Water System. Three triplex power pumps, each 9 x 12, claim 775 gallons per minute capacity, each supplying salt water by 8-inch pipe to a 2,200-gallon tank in fourth story building No. 1; these pumps are not built for high pressure and as there is no check valve at the top of this system, the highest available pressure is about 25 pounds. Pumps supply outlets inside and outside of buildings Nos. 1 and 6. In addition to these systems there are a few outlets on a Well Water System supplied by a small pump available for about 160 gallons per minute; also two other service pumps with one hose outlet each, which are available in emergency for about one stream. There are about 35 hose stations, some on one system, some on the other and some have outlets in duplicate. Stations are equipped with 100 feet of 2½-inch linen hose, kept in metal boxes, not coupled to outlets.

Neighboring Fire Equipment Available — Steinway Piano Company has an underground system of 6-inch cast iron pipe with three-way hydrants distributed about yard: hydrants have two 2½-inch hose outlets and one 4½-inch steamer connection. Steamer connections were installed 15 years ago and would not fit the threads of present steamer; system is kept filled with fresh water from a 5,600-gallon tank on roof of four-story factory, but in an emergency from a 16 x 9 x 12 pump, taking salt water suction from the river by 14-inch suction pipe. Pump is kept primed by 8-inch connection into suction from a 20,000-gallon tank in mill yard; hose available for outside use consists of about 2,000 feet of 2⅝-inch cotton rubber-lined hose with 1⅛-inch nozzles on six hose carts. — Astoria Veneer Mills — An underground system of 8-inch cast iron main to three-way hydrants with individual valves at outlets, also three outlets on the fire pump in yard. Supply consists of 50,000-gallon tank on 100-foot trestle and a 1,000-gallon pump, taking suction by 12-inch

pipe from the river (salt water), this pipe being kept constantly primed by an ejector. There is a liberal supply of hose, part linen and part cotton rubber lined on three hose carts. Buildings are equipped with automatic sprinklers, dry pipe system.

Public Protection — Nearest City hydrants located on Riker Avenue, 1,000 feet distant on 6-inch pipe, dead end, 40 pounds static pressure, but tests drawing 1,000 gallons per minute show pressure falling very low. Two nearest fire companies located on Flushing Avenue near Tenth Avenue and near Astoria Ferry respectively.

Alarm Service — Oakes Manufacturing plant was equipped with a 17-station combination manual fire alarm and watchman service.

Weather Conditions — The Weather Bureau records for the day of the fire show the following wind conditions — Direction of wind, northwest:

Time P.M.	12:01	1:02	2:03	3:04	4:05
Average velocity in miles per hour	52	53	48	54	53
Maximum velocity " " "	60	61	56	63	60

The fact that there was a 60-mile gale blowing was corroborated by all observers.

Origin and Spread.

Shortly before 12 noon of the day of the fire, there were two electricians at work installing iron conduits on the ceiling of the first floor of Building No. 19. In the course of this work one of the electricians had reached a point over a roll-top desk located at about the center of the building. He asked the foreman in charge of the floor to remove the desk; the latter refused. Alongside of this desk there were six full kegs, each containing about 110 pounds of chlorate of sodium, and a seventh keg opened and partly empty; the kegs were of light wooden construction and lined with paper. The electrician to continue his work, attempted to set up his ladder over the desk. The angle, however, at which he was forced to place it was such that the ladder was too short and it fell, breaking a gallon bottle about half full of sodium bisulphite solution, which was resting either on the desk or on one of the barrels; the contents of the bottle apparently fell into the open barrel of chlorate of soda and a violent chemical reaction ensued and flames were seen issuing from the barrel almost immediately. (Note — The reaction of sodium bisulphite with sodium chlorate would probably liberate chloric acid, free oxygen or both. Chloric acid in contract with organic matter, as paper, will cause it to ignite spontaneously; in any event a chemical reaction generating considerable heat in the presence of free oxygen would be likely to produce fire). The foreman immediately ran to stretch a hose line from the standpipe located at the stairs, assisted by the electricians; the hose, however, kinked and they were unable to straighten it and get water before they were driven out by the flames and fumes of the fire which spread with great rapidity, attributable to the decomposition of the sodium chlorate by heat, forming

free oxygen. This building was soon entirely in flames and is reported to have collapsed about 12:15 p. m. From this building the fire spread to the logwood piles to the north and side of No. 17 building, but was confined to one side and the roof of the latter building. Fire brands driven by the high wind set numerous fires in the premises of the Astoria Veneer Mills to the eastward.

Alarm.

In the excitement and confusion, it was apparently some time before an alarm was turned in. The Oakes Manufacturing Co. report that three different boxes of the National District Telegraph Co.'s manual system were pulled, but failed to record the alarm. The explanation given is that the wires were fused by the fire before the boxes were pulled. (Wires of the telephone company were utilized for the alarm service and the telephone went out of service about the same time). The first recorded fire alarm was sent in 12:03 p. m. from a manual box of the Consolidated Fire Alarm Co.'s pneumatic system at the Astoria Veneer Mills, where the fire was seen from the office. Five subsequent alarms were turned in.

How the Fire was Fought.

Following the first ineffectual attempt to use the hose line described above, other lines were stretched by employees of the Oakes Manufacturing Co. It is reported, however, that the salt water pump failed to pick up water and it was considerable time before streams could be obtained. Subsequently a number of streams were in use supplied by the 14 x 12 x 12 duplex steam pump (salt water). Other streams were supplied from the power pump, being taken across the roof of the buildings from outlets in Buildings Nos. 1 and 6 and it is reported that two were supplied from the fresh water standpipe system. Steinway Piano Co. reported first water on the fire. An employee of the mechanical department gave notice of the fire and the private fire brigade responded as the 12 o'clock whistle was blowing. They stretched two lines of 2½-inch hose with 1⅛-inch hose nozzles down between Buildings Nos. 17 and 19. They were forced to retire from this position later, but protected Building No. 17 throughout the fire, also working on the log piles. These lines were in service throughout the fire, the fire pump running without a hitch,maintaining 80 to 100 pounds pressure from 12 noon to 8 the following morning. It is very likely that other streams than these were taken off the pump, which was running at a high rate of speed, either by other employees or members of the Fire Department. At the first notice of this fire the Astoria Veneer Mills shut down, and the entire force of the company were engaged either in actively fighting the fire or in watching the roofs of the buildings, lumber yards and other property. They first started to assist at the Oakes plant, but soon found it necessary to confine attention to their own mills and yard. The exposure to the buildings, logwood and lumber piles of the Astoria Veneer Mills lying to the east of the Oakes Manufacturing Company was extremely severe, due to the high wind and

the showers of flying sparks. The difficulty of fighting the fire was accentuated by the clouds of smoke, so dense as to obscure vision for more than a few feet. Exposure was especially severe on the two-story corrugated iron logwood chipping mill (No. 38) on the boundary line between the two plants and directly in the line of the fire. To protect this mill two lines were operated from the engineer's shanty located half-way up on the derrick used to raise large logs of mahogany to the dock; these lines were played on the west side of this building throughout the fire. In spite of them, fire entered several times the somewhat dusty chip conveyor head room on the second floor near the water end of the building, probably through a one-inch space around an engine exhaust pipe; three sprinklers opened here and extinguished the fire, the dry pipe valves operating properly and the water-flow gong giving the alarm. Blazing brands were also carried entirely over this building and set fire in a clothes locker on the first floor near the easterly wall, entering probably by a small hole in the floor, where three sprinklers operated and extinguished the fire. In the yard with its piles of logwood, lumber and scrap covered docks, rapid fire fighting was necessary. Fire catching in one place was no sooner extinguished, than it would break out elsewhere, even mahogany logs two feet square with smooth surfaces catching fire with unexpected facility. Fire caught under the dock and ran for some distance before it was observed and extinguished. A number of 1⅛-inch streams were kept constantly busy extinguishing fires; the 1,000-gallon fire pump was undoubtedly discharging over its capacity, supplying Fire Department as well as private fire streams, but it ran 24 hours without a stop. The first fire companies to arrive operated lines on the south side of the fire, one or two streams taking suction from private hydrants, one company only laying lines from the distant public hydrants on Riker Avenue. The greater part of the Fire Department work was the operation of lines from the two fire boats, used principally to quench the fire in the logwood piles to the north of building No. 19. The gnarled and crooked shape of the logwood sticks insured plenty of surrounding air for combustion and made a stubborn fire which burned deep into the heart of the pile. There were about eight lines of 3½-inch hose with 1½-inch nozzles on this pile, as well as two 2-inch deck pipes from the fire boats. Six engine companies, two fire boats and four hook and ladder companies were working on the fire. Five lengths of 2½-inch and one length of 3½-inch hose burst during these operations.

Loss of Life.

At the time of the fire there were six persons in the laboratory, and in the office ten, consisting of the secretary and treasurer of the concern and an office force comprising two men and six girls employed as bookkeepers, stenographers and telephone operator, the tenth being a mechanic employed in putting on double windows. After the first notice of fire the six chemists in the laboratory escaped. They had apparently ample time, for one was able to return and get a bicycle belonging to a

friend and belongings of his own; the mechanic at work on the windows gathered up his belongings and jumped from the window to the logwood pile, calling to the others to follow. Among the office force, however, a little too much of leisurely coolness in putting away books and papers, a failure to realize the danger, caused them to neglect their opportunity to escape; they were last seen going for their wraps and were apparently overcome by fumes before leaving the office. The products of combustion were apparently so much more deadly than ordinary smoke as to overcome the employees almost instantly as evidenced by the fact that they failed to reach the exits or even the windows; the fumes probably contained chlorine gas from the decomposition of the sodium chlorate, and poisonous fumes from carbolic and oxalic acids, formaldehyde and other poisonous chemicals stored on the first floor. The location of the bodies after the fire indicated they had never left the office; an examination of the safe showed the books to have been placed therein in an orderly manner and one of the doors closed. The arrangement of the partitions with reference to the exits show the latter to be less adequate than a first glance would indicate. A fire originating as this one did might cut off the inside stairs and at the some time send up smoke and fumes through them and the open barrel hoist, which would cut off access to the outside stairs on No. 18. The iron stairs on No. 19 ran in front of unprotected windows and the last man escaping by them was overcome by fumes and fell rather than walked to the ground.

Damage.

Building No. 19 together with its contents was totally destroyed. Building No. 18 was saved in part but a large portion of the contents was destroyed. The west wall and roof of Building No. 17 was partly burned off, but the damage to contents was not material. The north wall of the coal pocket was burned and the fire ate deeply into the logwood piles to the northwest; a curious fact about this latter being that in places where the fire streams had preserved the surface logwood intact, masses of deeply charred or totally burned logwood were found underneath. In the two-story corrugated iron chipping building, No. 38, of the Astoria Veneer Mills, fire damage was confined to the slight burning of woodwork and contents in the locker on the easterly side of the building and to the conveyor head room on the second floor on the west side. Water damage resulted to contents (principally logwood chips in buildings) and to motors, belts and machinery from the sprinklers operating, from hose streams used to protect the west wall, which would occasionally shoot through broken windows, and also from the leakage from hose operated for a time through the windows of the building. In the yard behind the building 32 fires are stated to have occurred, all of which were extinguished before they had opportunity to do more than char the logwood or mahogany and oak veneer logs, the only exception being a fire which caught underneath the dock and ran along for a considerable distance before it was discovered and extinguished.

Conclusions.

The tragedy of the loss of these nine lives showed overconfidence to be fully as dangerous as panic. All occupants should leave a building in which fire occurs without delay.

The fire was occasioned by the overturning of bisulphite of sodium — a chemical not dangerous in itself — into a quantity of chlorate of sodium, a substance well known to be dangerous on account of its capacity for liberating oxygen, and which should have been stored in an outside building in conformity with usual practice regarding chlorates, nitrates and other oxidizing agents.

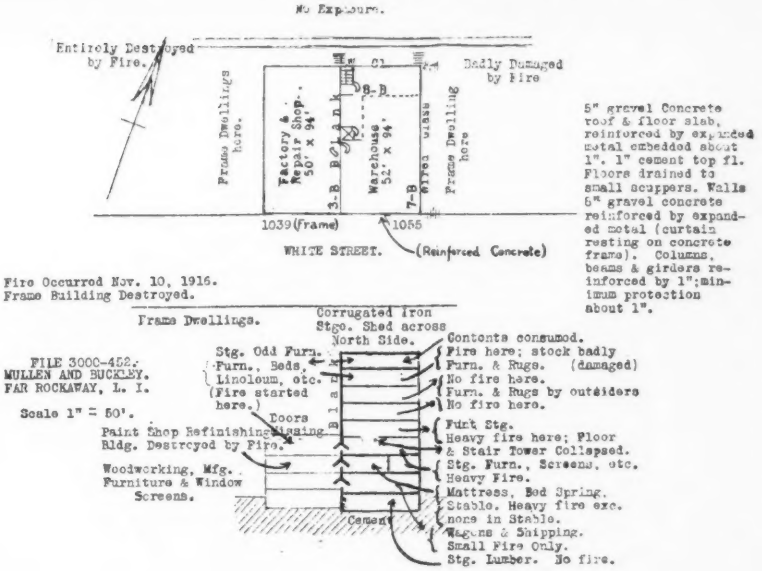
The spread of the fire was in large measure due to improper installation of hose on a system without adequate water supply.

The intelligent and efficient use of well designed private fire apparatus in two neighboring plants, confined this fire practically to the buildings in which it started, in the midst of a group of large frame buildings, log wood and lumber piles and combustible docks, with a 60-mile gale blowing.

Public fire-fighting forces should not connect steamer suctions to private hydrants of systems which are already supplying streams under adequate pressure, when any other source of water supply is available.

Fire-resistive Building in Exposure Fire

H-11811. Fire started shortly after midnight from an unknown cause in a paint shop on the third floor of a frame building occupied as a furniture and window screen factory. The outbreak was observed by a policeman who sent in a fire alarm. The fire department was only three blocks distant, but by the time the firemen arrived, the entire roof of the building was on fire. There was no chance of saving any part of the structure and it quickly burned to the ground, incidentally starting some seventeen separate fires in the neighborhood from burning embers. All the efforts of the firemen were concentrated upon saving the adjoining and surrounding property, and in this they were successful except in the case of a large adjoining warehouse of fire-resistive construction. The fire here took eight hours to get under control and was not extinguished until eighteen hours had elapsed. The warehouse consisted of seven stories and a basement, being 82 feet in height from the street level to the roof line. It had 52 feet of frontage and was 94 feet deep, comprising a total area of 4,888 square feet. There were gravel concrete curtain walls, eight inches thick, reinforced with expanded metal embedded about an inch. The parapet was three feet on all sides, not coped. Partition walls were six-inch terra cotta. The basement walls were of concrete, the foundations consisting of stepped concrete piers. All reinforcing bars were corrugated truss bars. The roofs and floors consisted of slabs of gravel concrete, 5 inches in thickness, reinforced with expanded metal. The slabs were


No Exposure.
Entirely Destroyed by Fire.
Badly Damaged by Fire
Frame Dwellings here.
Factory & Repair Shop 50' x 94'
Warehouse 52' x 94'
Frame Dwelling here
1039(frame)
1055
WHITE STREET.
(Reinforced Concrete)
5" gravel Concrete roof & floor slab, reinforced by expanded metal embedded about 1". 1" cement top fl. Floors drained to small scuppers. Walls 8" gravel concrete reinforced by expanded metal (curtain resting on concrete frame). Columns, beams & girders reinforced by 1"; minimum protection about 1".
Fire Occurred Nov. 10, 1916.
Frame Building Destroyed.
Frame Dwellings.
Corrugated Iron Stge. Shed across North Side.
Contents consumed.
Stg. Odd Furn.
Furn., Beds, Linoloum, etc. (Fire started here.)
Fire here; stock badly
Furn. & Rugs. (damaged)
No fire here.
Furn. & Rugs by outsiders
No fire here.
FILE 3000-452.
MULLEN AND BUCKLEY.
FAR ROCKAWAY, L. I.
Scale 1" = 50'.
Doors
Furt Stg.
Heavy fire here; Floor & Stair Tower Collapsed.
Paint Shop Refinishing Rdg. Destroyed by Fire.
Stg. Furn., Screens, etc.
Heavy Fire.
Woodworking, Mfg. Furniture & Window Screens.
Mattress, Bed Spring.
Stable. Heavy fire exc.
none in Stable.
Cement
Wagons & Shipping.
Small Fire Only.
Stg. Lumber. No fire.

supported by concrete beams, 14 by 18 inches in size, spaced 25½ feet. The girders were reinforced with corrugated steel rods, and there were light steel bars in the form of a T at corners of beams and girders. The interior finish was open, and there were no cornices. The columns were 14 inches square at the top floor and 36 inches square in the basement. They were reinforced by one-inch vertical rods (usually 8 in all) and light circular hoops about an inch apart vertically. The roof covering was slab tilted, graded for drainage, topped with an inch and a half of cement grout, covered with tar and slag. There was an inch of cement surface finish. The floors were not tilted, but drained to small scuppers. They were not waterproofed. There were wired glass skylights, without screens, over penthouses. The roof structures consisted of (1) a 6-inch terra cotta elevator pent house, with openings protected by fire doors, (2) a corrugated iron storage shed at the north end. The ceilings were smooth paneled face, close plaster finish. The stair towers and elevator shaft were built of 6-inch terra cotta blocks laid up from the floor slab without framing. Door openings were protected by approved fire doors. The stairs were of concrete, with platforms hung from floor beams by steel rods. Cement treads, platforms and landings. A horse runway between the first and second floors was open, without curtain boards. There was no vent shaft. The window-openings were protected by standard wired glass windows on all sides.

The frame building consisted of three stories and a basement, while the warehouse had seven stories and basement. The buildings com-

Photo No. 1.

municated on the first, second and third stories, the openings being equipped with standard automatic fire doors on both sides. The west wall of the fireproof building above the roof of the frame building was a blank concrete wall.

A heavy wind was blowing toward the northeast which blew the flames directly against and over the fireproof building in which fires were started in the first, second, third, fourth and seventh floors. The roof house also was considerably damaged and the contents (mainly furniture) destroyed. Fire did not enter the fifth and sixth floors or basement.

Fire appears to have communicated to the fire-resistive building through the door openings, the damage being most severe in the

Photo No 2.

Photo No. 3.

center of the west wall where the openings were located. These doorways had automatic sliding fire doors on the factory side and automatic swinging doors on the warehouse side. Adjacent to the doorway was a fireproof elevator shaft, but there were no openings from this shaft to the frame building.

The fire chief is of the opinion that these fire doors were not closed and that they did not operate properly. This would appear to be borne out by the fact that the wall on the factory side, in the first and second stories, where two fire doors remain, showed protected or unsmoked areas where the doors would have protected the wall if they had been open. The door in the third story on the factory side fell with the building. The swinging doors on the warehouse side of the openings were apparently swung back against the wall of the elevator enclosure as that side of the doors was comparatively bright and clean while the other side was badly burned and blackened. Just why the automatic attachments did not work could not be determined. In addition there were several pipes through this wall which broke off when the frame building fell, thus leaving fair sized holes through the wall. One of these can be seen in photo No. 1 accompanying this report.

Fire in the first floor did not do a great deal of damage and was apparently extinguished without much trouble. The stable which is partitioned off on the east side of the second story was not damaged, but several horses were suffocated. The main part of the second floor, which contained a stock of furniture, was badly damaged, and the ceiling construction in this part was somewhat spalled. The heaviest fire was in the third and fourth floors. There was no fire at all in the fifth

Photo No. 4.

and sixth but in the seventh a considerable amount of damage was done to furniture in storage. The fire must have entered the seventh floor either through the elevator shaft from the floors below or from the burning roof house on top of the building. None of the wired glass windows on the ends appeared to be melted out and the fire chief stated that the broken windows were all broken by the firemen to ventilate the room and to let the smoke out. Loss from fire will be heavy in the second, third, fourth and seventh stories and roof house and there will be considerable water loss in the other floors.

As above stated, the most severe fire appears to have occurred in the third story. There was a considerable amount of furniture stored on that floor and the heat so badly damaged the concrete members of the floor above that part of it collapsed. Photo No. 2 shows one bay where the floor slab is hanging to the fourth floor and down into the third story. One of the girders at this point seems to have given way entirely. From photos Nos. 3 and 4 it can be seen how the concrete members were affected by the heat. The heat was undoubtedly very severe, but it also seems that the reinforcing members were placed nearer the surface of the supporting members than is usual in construction of this kind. The third and fourth stories were pretty badly damaged and it was at first thought that it would be necessary to tear down the building. An attempt to strengthen and make over the present structure will, however, be made.

During the course of the fire four alarms were turned in and apparatus responded from neighboring districts. It is claimed that there were nine steamers in all averaging two streams each. Public water pressure from which steamers were drawing was raised to 60 pounds to supply steamers, and it is claimed that there was an ample supply of water.

Fire in Electric Transformer and Switching Station.

Station of the Hydro-Electric Power Commission of Ontario, located near Dundas, Ontario.

Special Report by Canadian Fire Underwriters' Association.

Construction.

The building consisted of a basement and one story of a height equal to two. It was 42 feet high and covered an area of 14,250 square feet, being built in the form of an L — extreme length 285 feet, length of L 60 feet, extreme width 80 feet, mean width 42 feet. The walls were of brick, pilaster construction; windows in all outside walls had metal sash and wired glass, except in the case of the openings for the 110,000 volt wall bushings, which were surrounded by ordinary glass in wood frames; the doors were of wood, and the roof of reinforced concrete resting on walls and metal beams and girders. All the beams and girders of the roof, floors and bus bar structure, together with the H-columns supporting the floors, roof and bus bar structure, were unprotected. The floors were of concrete; there were iron stairs open to basements. No finish.

Equipment.

Electric lighting, wires in conduit (part of lights on storage battery); steam and electric heating; standard conductors, all high tension conductors of bare copper or aluminum with ample clearance; switchboard of standard incombustible type, remote control for all 13,200 volt and 110,000 volt oil switches (all oil switches having automatic overload release); twelve lightning arresters of electrolytic type, each containing 500 Imperial gallons of oil on each conductor; six transformers — 1250 K. W. oil immersed water cooled type. The thirty-six 13,200 volt oil switches, each containing 350 Imperial gallons of oil, were not installed in fireproof compartments; neither were the six transformers and the twelve lightning arresters. Twenty-four arresters of similar type were located outside. The total amount of oil in the whole electrical equipment installed in a common room on the grade floor was approximately 35,000 Imperial gallons.

Housekeeping and Protection.

There was a small supply of lubricating oil in metal can; a number of metal drums containing oil for switches was stored in the east basement; two metal tanks, each of 3,000 gallon capacity and having detachable tops, were located in the west basement and connected by pipes to the transformers and switches, being used for cleaning oils. The tanks were normally empty. At least two attendants were on duty at all times. Twelve pails of sand were available, together with six one-quart chemical extinguishers and about five gallons of liquid in reserve. There were no water pails; nor were there any vertical pipes and hose, fire alarms or external protection of any kind. The building was seven years old and

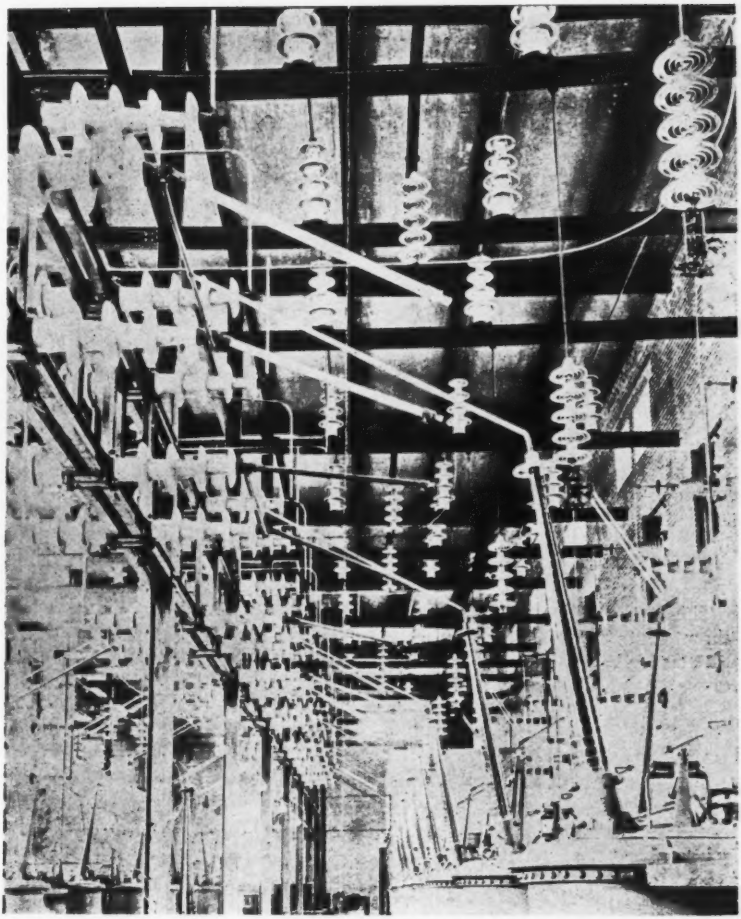
INTERSWITCHING STATION, DUNDAS, ONT.

Subsequently to the above photograph an addition of approximately 90 feet was built at the extreme right or east end of station.

in good condition. The care and maintenance were good, and there were no exposures.

The Fire.

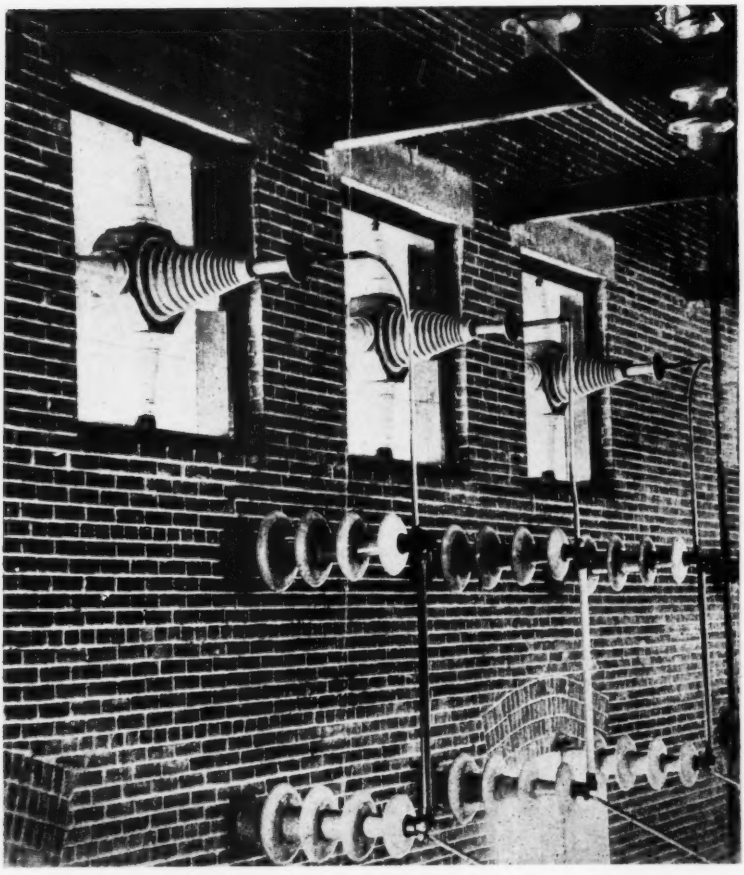
About 3 a. m. on 31st July a breakdown occurred in one or more of the 110,000 volt "bus tie" oil switches located on the grade floor at the extreme East end of the station; the tank of switch was disrupted by a minor explosion or by the sudden expansion of the oil or vapor inside, and the burning oil escaped and spread over the floor and into the basement through the open stairway. The incoming 110,000 volt current from Niagara Falls is said to have been cut off from all four trunk lines at the Niagara Substation shortly after the fire was discovered. The three attendants on duty fought the fire ineffectually with one-quart chemical extinguishers and sand from pails; during the progress of the fire a number of minor explosions occurred and seven oil switch tanks were entirely emptied and five others partially emptied. This oil together with that from twelve lightning arrester tanks and from four to six metal drums stored in the basement, aggregating about 9,000 Imperial gallons, fed the fire. The burning oil generated a severe concentrated heat, accompanied by dense smoke; the unprotected metal beams and girders of the roof and floor and the metal columns supporting the basement ceiling and roof girders buckled, the floor gave way, and a number of oil switch and lightning arrester tanks were precipitated into the basement; approxi-



HIGH TENSION INTERSWITCHING ROOM, DUNDAS STATION.

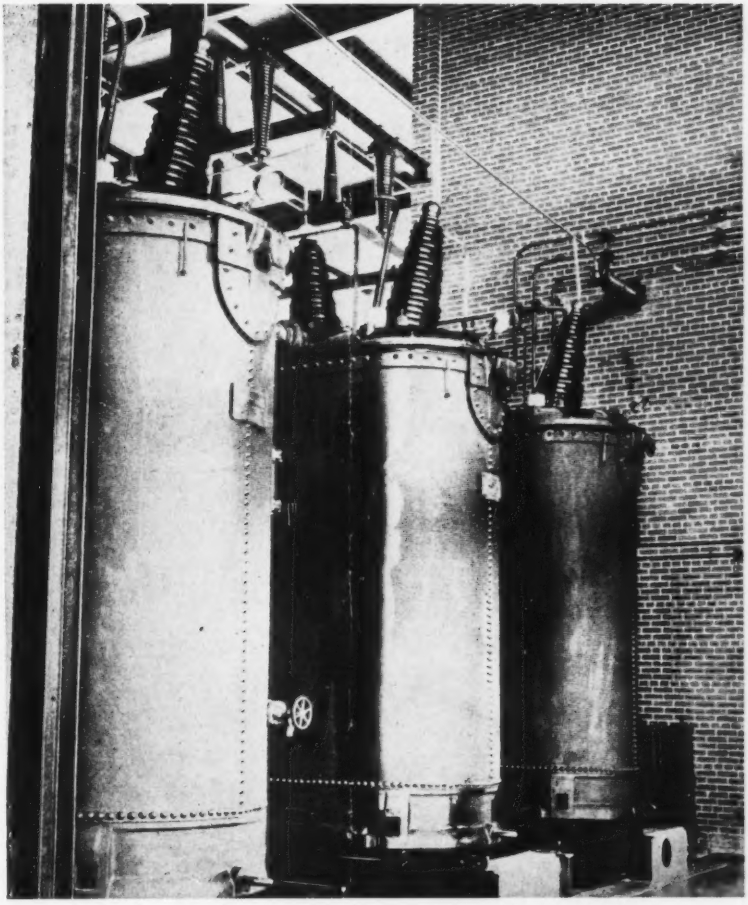
Showing exposed steel columns, girders and beams. Upper windows on right had metal sash and wired glass. Openings for wall bushings lower down were surrounded by ordinary glass in wood frames.

mately sixty feet of the roof fell, and several additional bays were damaged; the upper section of the East end wall collapsed and the side walls were also damaged; the East end of the station for a distance of about 90 feet will have to be rebuilt. Practically the whole of the station was affected by the flames, heat or smoke, some fifteen of the thirty-six oil switch tanks were damaged (seven seriously), and the remainder will require minor repairs in respect to "condenser" bushings, actuating gear, etc.;



Shows porcelain wall bushings exactly similar to those in use at Dundas Station.

all the large 110,000 volt wall bushings and mountings were destroyed; the aluminum and copper tube bus bars were reduced to scrap, the disconnecting switches were damaged, and all the supporting insulators broken; the 13,200 volt lightning arresters installed on a fireproof gallery at the extreme West end of station and the six large oil immersed transformers located on the grade floor of this section were protected to some extent from the heat by a curtain wall, and escaped serious damage. The fire burned until about 8 a. m. of the same day, and was extinguished by shovelling earth on the oil and through the assistance of the Dundas Fire Brigade, which was called at 4.25 a. m. and responded promptly. As previously noted under "Construction" this station had no water pro-



Shows arrangement similar to that in Dundas Station of 110,000 V. to 13,200 V. oil immersed water cooled transformers.

tection and the brigade was compelled to lay 3,200 feet of 2½-inch hose to the nearest hydrant connected to the Dundas Water works system (gravity supply). The loss is thought to be about $30,000.

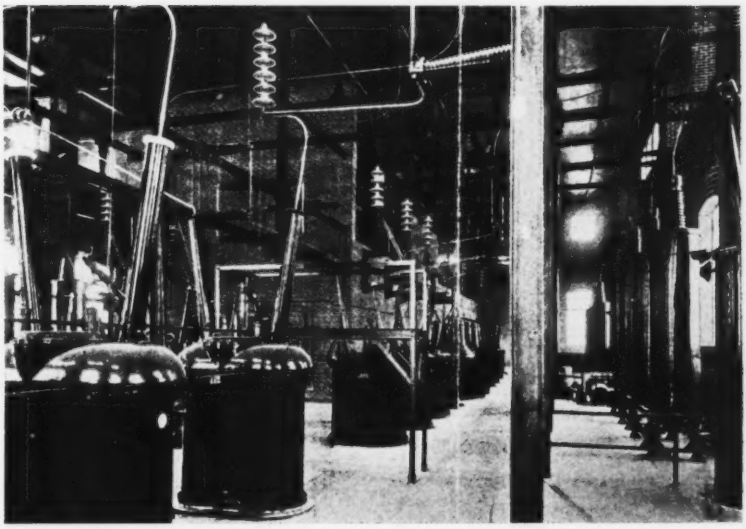
Remarks.

This station did not conform to standard in the matter of unprotected metal supports, excess height, oil switches, oil immersed transformers and lightning arresters not installed in fireproof rooms or compartments, inadequate fire protection, etc. The chief hazard to buildings of this class (omitting any possible exposure hazard) is from escaping oil from a

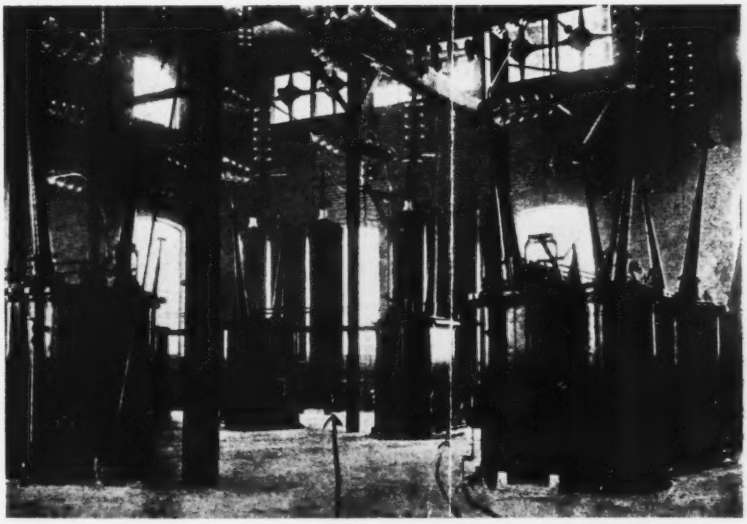
DUNDAS STATION AFTER THE FIRE.

1. Extreme east end of Station, south corner. Note cracks in wall, wall bushings burned out, wired glass gone, steel sash O.K. Note basement and ramp leading thereto. 2. East end wall on north side. 3. Station from west end (opposite to origin and seat of fire). Note distance of break (in south wall) from east end. 4. North-east corner of Station. Note section of east end wall gone. 5. Interior of Station, east end. Note buckled steel. 6. East end wall. Note cracks in brickwork and section of top wall gone.

switch, lightning arrester or transformer case becoming ignited, either from electric arcs within the tank or case or by contact with a heated surface (furnace fire, electric heaters, etc.) after leaving the case. Heavy duty oil switches, that are operated frequently under load in stations like this one, interposed between the generating station and the whole load, unquestionably constitute a greater hazard than oil immersed transformers or electrolytic type lightning arresters. The cause of breakdowns in these types of devices may be roughly attributed to the following: — *Oil Switches* — Line surges from electric storms, short circuits, varying loads, arcing grounds, swaying conductors; moisture or carbon in the oil; low oil level; imperfect contacts; overloads, etc. *Oil Immersed Transformers* — Water Cooled Type. Much the same causes as noted under "Oil Switches." In addition, water due to condensation or leaks in the cooling coils frequently escapes into the oil and results in burn-outs; the ab-



Shows station similar in construction to Dundas Station as regards unprotected steel, floor without pitch or drain, oil switches on common floor, electrolytic type arresters on common floor.



Shows station similar to above with exactly the same electrical equipment as that in the Dundas Station.

sence of movable current-carrying parts in transformers practically eliminates the danger from imperfect contacts and the presence of carbon in the oil. *Lightning Arresters* — Electrolytic Type. These have been comparatively free from internal accidents resulting in fires, but the storage of large quantities of mineral oil within the tanks in a common room represents a hazard. The oil used in the switches, transformers and arresters was a pure mineral oil having a burning point of approximately 200 degrees C. (392 F.). The tanks of the oil switches are constructed of heavy steel plate, having cast iron bases and covers provided with heavy connecting flanges, and are practically air tight except for a small vent at the top; this vent is designed to allow for the expansion of the oil under normal and even severe switching conditions, and the current-carrying sections have a high factor of safety, probably 400%; the tanks of oil switches operating on extra high voltages are at times subject to high stresses from the abnormally severe arcs frequently encountered on systems supplied on the bus bar plan from stations having large capacities.

Conclusion.

The conditions which caused the fire to attain such large proportions were: — Inadequate fire protection; oil switches and electrolytic type lightning arresters not installed in separate fireproof compartments. Also oil immersed transformers were not cut off, but distant from origin of fire and not seriously damaged. All of these were located on a common concrete floor not provided with drainage; stairway to the basement was not cut off nor provided with a raised curbing around opening; metal supports were unprotected and the undivided area of the station was too large. The storage of transformer oil in metal drums in the basement, the distance of the station from any organized Fire Department and the extra high voltage employed also had some bearing. The lack of ventilation and the extensive use of metal sash and wired glass in window openings tended to "bank" the flame, heat and smoke in the upper section of the station during the early stages of the fire — the heat and smoke traversed the full length of the structure. Improvements in the design of equipment for use on extra high voltages are being made from time to time by operating companies and large manufacturers. The trend of engineering practice is toward the regulation of the current flow under abnormal conditions, such as short circuits, etc. This is accomplished by the insertion of reactance units which are designed to prevent the equipment being subjected to undue strains. A less inflammable medium than mineral oil for use in the cases of switches and transformers may be discovered in the near future. It is also possible that certain improvements looking to the prevention and control of fires from break-downs in oil switches, oil immersed transformers and lightning arresters in existing stations of the type of this one could be carried out to advantage, but these would have to be designed with strict regard to the extra high potentials employed.

Fire in a Car Barn.

H-11810. A car was brought into the barn at about 5 p. m. with a hot air pump and a hot journal, and was examined by an employee who then left the car to go to the office. Fire started before he had returned to the car.

Construction. — The barn is one of the largest, and also the latest of the system, having been erected in 1913.

Outside Walls — 13-inch brick pilasters 17 inches by 25 inches, 16 feet on centres.

Roofs — Slag on reinforced concrete slabs, on reinforced concrete trusses, on reinforced columns.

Skylights — Wired glass in metal frames, every tenth pane of glass being thick plain glass for smoke exit.

Divisions — Car house is divided into 13 bays by 6-inch hollow tile division walls with 14-inch by 14-inch reinforced concrete columns. These columns support the concrete roof, and the tile walls act only as curtain walls. Each division wall has one opening protected by double standard fire doors. Size of each division approximately 38 feet by 497 feet containing a total of 1500 track feet each.

Inside Protection — Each of the 13 bays is provided with two 2½-inch standpipes with 100 feet of 2½-inch linen hose and 1-inch nozzle. Standpipes supplied by 4-inch pipe from 6-inch city main, 35 pounds pressure, also 12 pails and 8 chemical extinguishers in each section. A private brigade is well organized and drilled regularly.

Outside Protection — Fourteen public hydrants within 200 feet on 6-inch and 8-inch mains, gridironed. City department three blocks distant. System of public and local auxiliary fire alarm boxes in risk.

Story of the Fire — The fire occurred in bay No. 11 near the centre. An employee states that he brought a car into the car house from street; the car was turned in for hot air pump. He pulled the car to the centre of bay, threw hood switch off, turned seat up over air pump, but saw no evidences of fire. He removed pole from trolley, and left car. He observed that the journal box was hot. He went to the office and on returning heard the local alarm bell ring, same having been rung by another employee who noticed the car on fire. Box was pulled at about 5 p. m.

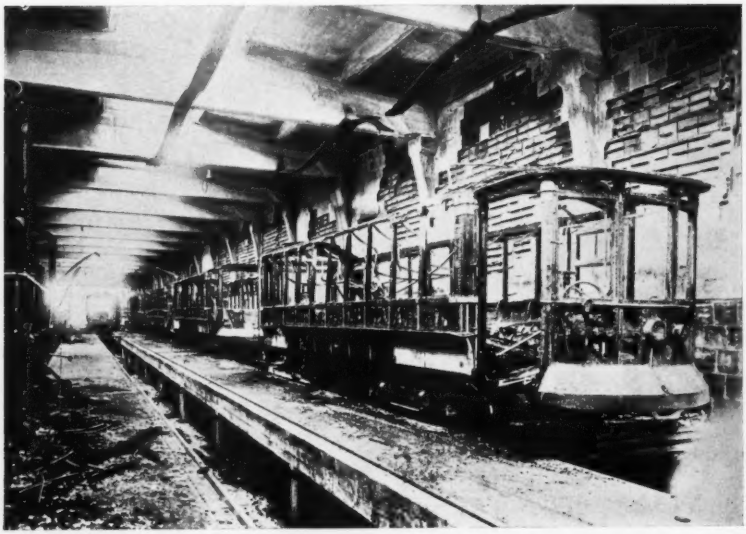
A foreman states that the alarm came in from an auxiliary box and 16 men responded. On account of the day (Sunday) less than half the usual number of men were on duty at that time. There were 24 cars in bay No. 11, distributed as follows — 11 cars each on tracks No. 1 and 3, and 2 on track No. 2. With help from the trainmen 14 cars were removed from the barn, the remainder of the cars being so near the centre of the car house that it was impossible to remove them. The barn men started

to fight the fire with six hose streams, the blaze spreading so rapidly that the chemical extinguishers and pails were of no value. The heat was so intense that several of the hose lines were damaged. At 5.05 p. m. the dispatcher sent in another alarm from the auxiliary located in his office opposite, as the public fire department had not responded, and did not respond until about 5.09 p. m.

The response was due to a still alarm sent in at 5.07 p. m. by a woman who lives in a neighboring house. The first alarm sent in by the discoverer of the fire and the second one sent in by the dispatcher failed to register thru the public box. On investigation the next day the trunk cable of the alarm system which is run in conduit in a concrete tunnel under the street, was found badly grounded owing to a heavy rain on the preceeding Friday. A lead covered cable is to be substituted for the present method of installation.

Damage to Cars. The ten cars which could not be removed were destroyed with exception of wheels and trucks.

Building Damage. The principal damage was done to the 6 inch hollow tile walls. These tiles are 6 inches by 11 inches with an external wall of ¾ inch. The tiles are divided in a section forming four air spaces by internal cross walls of ⅝ of an inch in thickness. The blaze itself had no noticeable effect on the tiles until struck by water, when the exposed face of the tile cracked and shaved off flush with the dividing rib. On



Shows burned cars and destructive effect of water on hot six-inch hollow tile division walls.

the side of the wall remote from the fire there was no evidence of damage, no discoloration by smoke even being noticed. Approximately 5000 square feet of tile wall will have to be replaced. There are numerous places in the concrete floor where for a depth of from 1 inch to 1½ inch the concrete has been dehydrated, and is in a state of disintegration, and will have to be replaced. On some of the transverse members of the roof the edges are scaled off to a depth of 1 inch or more, but not enough to expose the reinforcing steel. In several of the longitudinal ribs of the roof slabs, cracks an eighth and a quarter of an inch wide and an inch or more deep were noticed, and at the junction of two units a crack of larger dimensions was observed, the larger one no doubt being caused by the disintegration of the grouting. The reinforcing steel did not appear to be exposed.

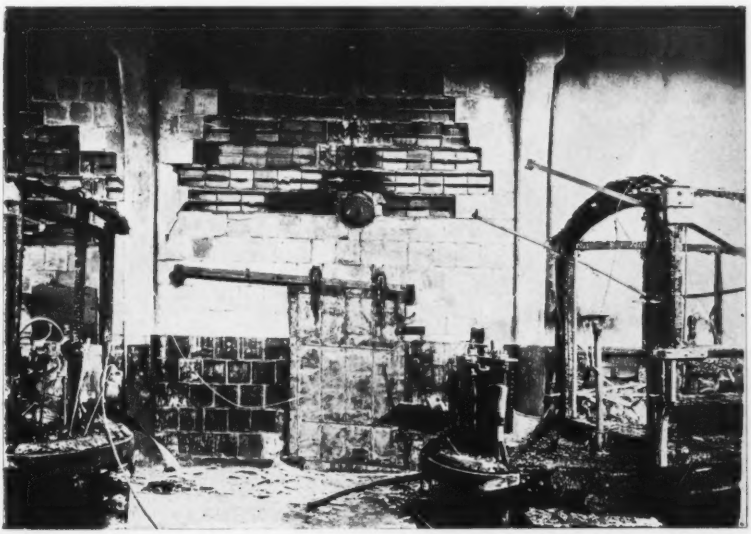
The columns do not appear to be damaged except for some surface scaling.

The wired glass skylights were badly cracked.

It has not yet been determined whether the damage to the trusses and longitudinal roof purlins is serious enough to require new members.

Fire Doors. The face of the fire door directly exposed to the blaze is still intact, while the other side has not even the paint marked. The track and other parts of the door are not damaged. The door was open before the fire and closed properly.

Loss on building and rolling stock is estimated by the assured at $40,000.



Shows automatic-closing tin clad fire door which operated satisfactorily and held fire in burning section.

Recommendations. Cars with overheated equipment should not be run into a barn among other equipment and allowed to stand there unattended. All such cars should be allowed to cool down before being run into the barn.

National Electrical Code rules should be observed in the installation of fire alarm apparatus.

The following orders were issued by the Company immediately following the fire:

I.

"To all Foremen:

Should a car be taken from the line or brought to the car house because of a hot journal, hot compressor, overheated rheostat, cable trouble, or in fact, in any condition from which a fire might start, you will see that your men make sure that every indication of fire is removed, and that there is no possible danger of a fire starting, in or on the car, before running it beyond the entrance of the car house or in close proximity of other cars.

This order is effective at once.

II.

"To all Concerned:

All trainmen when turning in cars where defect is due to hot boxes, cable troubles, overheated rheostat or air compressors shall make out O. K. card and turn same over to Car House Foreman or a Repairman before running car into car house."